S. 170.

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Transactions

OF THE

CITY OF LONDON

ENTOMOLOGICAL & NATURAL HISTORY

SOCIETY

FOR THE YEAR 1894.

PUBLISHED BY THE

CITY OF LONDON ENTOMOLOGICAL SOCIETY,

THE LONDON INSTITUTION, FINSBURY CIRCUS, E.C.

The City of London

Entomological and Natural History

Society,

The London Institution, Finsbury Circus. E.C.

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Days and Hours of Meeting: first and third Thursdays in the month, at 7.30 p.m.

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TRANSACTIONS

OF THE

City of London Entomological and Natural History Society.

1893—94.

Reports of Meetings & Abstracts of Papers read.

Tuesday, December 19*th,* 1893.—Exhibits:—Mr. Battley; a short series of *Himera pennaria* from Epping Forest and bred specimens of *Eupithecia lariciata*; also several doubtful "Pugs" from Hale End, most of which were thought to be *E. castigata.* Mr. Prout; bred *Emmelesia alchemillata* from Sandown, also *E. affinitata* from various localities; there was no appreciable difference between the specimens, except the slightly superior size of the *affinitata.* Mr. Riches; *Orrhodia vaccinii* from Salisbury. Mr. Clark; a series of *Thera juniperata* (bred) from Perth, concerning which he remarked that they were paler than the southern form, as is usually the case with this insect. Mr. Gurney; *Hybernia defoliaria* from Hale End, including some pretty varieties. Mr. Nicholson; one of the new opera glasses brought out by Mr. Aitchison of Poultry; this instrument is particularly suitable for field work on account of its extreme lightness (being made of aluminium), its compressibility, and the power and beautiful definition of its lenses. Dr. Sequeira; a short series of *Triphaena fimbria,* including a magnificent red specimen, also *Dasychira pudibunda* and *Hybernia defoliaria.* Mr. Southey; *Dicranura bifida* and *D. furcula, Notodonta palpina* and *N. dictœa, Cucullia chamomillae* and *C. umbratica, Epione apiciaria, Hypsipetes elutata* and *Camptogramma fluviata,* all from Highgate and mostly bred.

January 2*nd,* 1894.—Exhibits:—Mr. Stillwell; a variable series of *Hybernia defoliaria* from Epping Forest. Mr. Lane; a series of *Chelonia plantaginis.* Mr. Bacot; a bred series of *Vanessa c-album,* one of which had white triangular marks on the underside of the hind wings in place of the usual "comma" marks; he stated that this

species rested with its fore wings much further forward than is usual among butterflies, so that there was a larger interval between them and the hind wings, the habit serving to intensify its resemblance to a dead leaf. Mr. Bell; a specimen of a Noctua taken on sugar at Tooting Common, its peculiarity being that a semi-circular patch at the outer side of each fore wing was entirely devoid of scales; the patches were remarkably symmetrical; the specimen was considered by most of those present to be a ♀ of *Cerigo cytherea*. Messrs. Clark, Hill, Prout, Battley and Dr. Sequeira exhibited Scotch lepidoptera. Mr. Oldham; dragon-flies and bees from Cambridgeshire. Mr. Hill read a paper entitled "Random Notes on Collecting Lepidoptera in Scotland," which he illustrated by the contents of three cases. The paper was based on the writer's experiences at Rannoch, in August, 1891, and in the Orkney and Shetland Islands in August, 1892. Having described the locality, Mr. Hill passed in review the insects he had captured. Two specimens of *Vanessa urticae* were very strongly marked, and larger than those met with in the South of England. *Erebia blandina* was met with abundantly in one particular spot on the banks of the Tummell; any number might be taken by simply walking about in the grass and netting those that flew up; the species was, however, extremely local; its flight was very similar to that of *Epinephele ianira*, but it always disappeared entirely and refused to be kicked out, as soon as the sun went in; the species was also noticed in the Pass of Killiecrankie. It was too late for *Coenonympha typhon*, and only three specimens were secured; these were flying over the heather on the mountain sides at a considerable elevation. Two larvæ of *Smerinthus populi*, found on aspen, yielded in the following season two ♀ imagines which were much paler than the ordinary pale form, and were suffused with pink. *Dicranura furcula* was bred from one of two larvæ found on the same aspens, by Mr. Salvage; this was the first time Mr. Salvage had seen this species at Rannoch, although he had worked the locality for 15 or 20 years. *Cymatophora or* was bred from larvæ found on aspen; they spend the day between two leaves spun together, coming out to feed at night; the imagines are much smaller than those received from Winchester, and their fore wings are suffused with a pink or pale mauve tint. One female *Stilbia anomala*, was taken on the wing in the afternoon; it seemed to have a tendency to fly round in a circle, and its movements were exceedingly rapid. Pupæ of *Taeniocampa gothica*, yielded in the following spring, an interesting series of imagines, which vary considerably both in colour and in the usually dark central mark; in some of the specimens the mark is practically unicolorous with the rest of the wing. Are these the true var. *gothicina*? Sugar was an entire failure. Of Geometræ: *Larentia didymata* swarmed in every locality visited, the specimens being smaller and darker than the ordinary southern type. *Larentia caesiata* was also common, both at Rannoch and in the Shetlands; it was very difficult to discover, owing to its perfect resemblance to the rocks and stones on which it rested; the Shetland specimens are much more strongly marked, and have a much darker medium band than those from Rannoch. *Larentia rufi-cinctata*, of which a fair number were taken, also rests on the rocks at considerable elevations on the mountain sides, and is so exactly like a yellow lichen which grows freely on the rocks, that the practised eye is necessary to detect it. The variation of *Melanthia rubiginata* in

Scotland is considerable; a form occurs not infrequently in which the fore wings, and to a less extent the hind wings, are suffused with black. *Cidaria populata* was fairly common on the mountain sides flying over the heather; in some of the specimens the wing-markings were almost obliterated by a dark suffusion. *Cidaria immanata* was perhaps the most variable insect met with, in fact, no two specimens were exactly alike; the median area varied in colour from jet black to pure white; in the Shetland Isles a form is taken which is entirely different from any of those met with at Rannoch.

Jan. 16*th,* 1894.—Exhibits:—Mr. Hill; a specimen of *Catocala sponsa,* having a suffusion of black scales near the apical angle of the left hind wing. Mr. Battley; *Cheimatobia brumata,* of both sexes, the wings of the males showing considerable variation in the distinctness of the transverse lines. Mr. Clark; *Mixodia palustrana* from Perth; also a specimen of *Selenia lunaria,* bred on Christmas Day. Mr. Nicholson; two larvæ of *Pararge egeria,* about half-an-inch long, from a brood which is now hybernating indoors, on grass growing in a flower-pot. Mr. Bacot; living pupæ of *Taeniocampa munda.* Mr. Riches; *Agrotis segetum, Mellinea circellaris* and *Anchocelis pistacina,* from Salisbury; the *circellaris* were rather dark. Mr. Southey; a fine series of *Nonagria arundinis* (*typhae*) from Norfolk. Mr. Lane; *Leucophasia sinapis* from Reading, and *Abraxas grossulariata.* Mr. E. H. Taylor, of 52, Mimosa Street, Fulham, was elected a member of the Society.

Capt. B. Blaydes Thompson then read the following paper on:—

The PRONUNCIATION and ACCENTUATION of CLASSICAL NAMES.

There is nothing in what follows which can in any way lay claim to novelty. I have no new theory to propound, and the statements which I am about to make are neither new, nor do they in any way rest upon my authority. I do not, however, intend you to infer from this that they will not be new to you; on the contrary, I have no doubt that you will be as much surprised as I was at some of the discoveries which I have made during the preparation of this paper, especially as regards the accentuation of both generic and trivial names. I approach the subject with considerable diffidence; my object has been simply to compile and summarise, to the best of my ability, some of the leading points in this rather thorny subject, and to endeavour to make them sufficiently explicit to interest you.

About thirty-five years ago numerous complaints appeared in the *Entomologist's Weekly Intelligencer,* from Lepidopterists as well as Coleopterists, of the difficulties with which they had to contend both in pronouncing and in accentuating the Latin names of insects, and notwithstanding the gigantic progress which has been made in education since 1850, such difficulties are still felt by many. There are not a few well-educated and intelligent men, whose classical education has not been very extensive; when such are tempted out of the beaten track of commerce by the allurements of science, and find themselves forced to cope with scientific nomenclature, the difficulties attending the study of whatever branch they may select are greatly increased.

In consequence of the numerous synonyms in use amongst Lepi-

dopterists, there is considerable confusion and uncertainty with regard to the names of many species, and I venture to think that, by pronouncing or accentuating the name of an insect in such a manner as to make it sound like some other name, that confusion and uncertainty are increased.

As regards the term "pronunciation," it may be used as referring either to the two methods which exist in this country, to accentuation, or to quantity. Of the two methods of pronouncing Latin, one is called the "English," the other the "Italian," or more generally the "Continental." The difference between the two consists in the vowels being sounded differently, and in the letters *c* and *g* being invariably hard in the Continental method, whereas in the English method they are hard or soft, according to the vowel which follows them; hard before *a*, *o* and *u*, soft before *e*, *i*, *y*, and the dipthongs *ae* and *oe*. Into the question as to which of these methods is the better, I am not going to enter, but will simply say that each is right, viewed from its own standpoint, and that each is looked upon with favour by its patrons in the United Kingdom. At Oxford the English method is adhered to, whilst at Cambridge the Continental is adopted to some extent; nor is there uniformity of practice among the large Public Schools of the Metropolis, Christ's Hospital adopting the Continental method, Merchant Taylors' the English. Amongst Lepidopterists in Great Britain, the English method of sounding the vowels in pronouncing Latin words is almost universal, and although certain Cambridge scientists hold to the Continental pronunciation, the latter does not gain ground; we may accordingly set it down as *un fait accompli* that naturalists throughout the United Kingdom give the vowels the same sound when speaking Latin words that they do when speaking English. It is sometimes maintained that the adoption by us of the Continental method would secure uniformity of pronunciation amongst Europeans, and that thus an ideal "International pronunciation" would become a reality. Strictly speaking, however, there is no "Continental" method, for, as a matter of fact, each nation pronounces Latin after the analogy of its own tongue. In the sound of the vowels, it is true, there is a general sort of agreement, but as regards the consonants there is the greatest diversity of usage. If the Continental nations had attained to an approximate uniformity among themselves there would be reason in the suggestion, but as the matter stands it cannot be logically supported. As an example of the diversity in Continental pronunciation we will take the word *Cicero*; the French pronounce this *Seesayro*, the Germans *Tseesayro*, the Italians *Tcheechayro*, and the Spaniards *Theethayro*.

The result of the correspondence in the *Intelligencer*, to which I have already referred, was that the task of compiling, editing and publishing an *Accentuated List* of the names of the British Lepidoptera was undertaken jointly by the Councils of the Entomological Societies of the two Universities; the President of the Cambridge Society at that time was Charles Cardale Babington, and of the Oxford Society Rev. H. Adair Picard. In this work, which was published in 1859, every name then in use for Species or Genus is dealt with both as regards pronunciation and accentuation, and its derivation given.

The first fact that is patent on looking through the work is that the generic names are mostly derived from Greek words, the trivial

names from Latin. In the preface the following table of vowel sounds is given, with the intimation that "every vowel in the *List* is to be pronounced short unless marked long, thus ë":

"*a* is to be pronounced as in *hat*; *ä* as in *hate*.
e „ „ „ *met*; *ë* „ *mete*.
i „ „ „ *hid*; *ï* „ *high*.
o „ „ „ *hop*; *ö* „ *hope*.
u „ „ „ *duck*; *ü* „ *duke*.
ae and *oe* are to be pronounced as long *e*, *ei* as long *i*, and *au* as in *naughty*."

From this it will be seen that the sounds are to be exactly the same as they are in English. The mind of the student need not be unduly exercised as to whether a name is derived from a Greek root or from a Latin one, because from whatever language it has been derived, it becomes a Latin word when inserted in a list of Lepidoptera as applied to an insect. Having adopted the English method of pronouncing Latin words, the vowels and consonants which they contain must be sounded as they are in our own language. The English are acccused not only of departing from the genuine sound of the Greek and Latin vowels, but also of violating the *quantities* of these languages more than any other nation in Europe; but if the *quantity* be violated, it is not as chance may direct, but regularly and in accordance with the analogy of the English tongue, which, if not so well adapted to the pronunciation of Greek and Latin as some other modern tongues, has, nevertheless, as fixed and settled rules for pronouncing them as any other. I have so far discussed the two methods of pronouncing Latin as contrasted with each other, but wish now to call attention to the confusion of them which is not unfrequently heard in the pronouncing of a word partly in accordance with one method and partly with the other. The errors most common are sounding the *i* like our *e*, and the consonants *c* and *g* hard irrespective of the vowel that follows them; for example *dentina* and *blandina* are pronounced as if written *denteena* and *blandeena*, but the error is not consistently perpetuated in *aprilina*, *sobrina* and *pistacina*, the latter names apparently not lending themselves so easily to the practice. Again, take *Lycaena*; according to the English method the *y* is long, the *c* is soft, and the dipthong is sounded like a long *e*; in the Continental method the *y* is also long, but the *c* is hard, and the sound of the dipthong is like our long *a*. In the one case the pronunciation would be *liseena*, in the other *likayna*, but by pronouncing the wood *likeena*, as is often done, the two methods are mixed, and this pronunciation is incorrect, Another instance is the familiar *fagi*; in the English method the *g* is soft and the proper pronunciation rhymes with *magi*; in the Continental method the *g* is hard and the word is pronounced *fahgee*; but if the English vowel sounds are retained, whilst at the same time the *g* is sounded hard, the two methods are mixed, and the rules of the English method violated. The cause of this, in a great measure, is the inference that is improperly drawn that, because the *g* is hard in the nominative case, *fagus*, it must continue hard throughout the declension, irrespective of the vowel that follows it; but this is erroneous.

To the best of my belief, the causes of a great deal of this confusion are to be found in these facts:—1. There is no letter *c* nor *j* in Greek;

2. There is no *k* in Latin; 3. The Greek letters κ and γ are invariably sounded hard in that language; 4. When a name (Latinised of course) which comes from a Greek root is given to an insect and contains the Greek κ, the letter *c* has to be substituted for the latter; 5. The letters *c* and *g* in English, have both a hard and soft sound, and which of the two is to be used depends upon the vowel that follows them. Reference to an English dictionary will reveal the fact, that whenever the consonant *c* is immediately followed by either of the vowels *a*, *o* or *u* the *c* is hard; but when *c* is followed by *e*, *i*, *y*, *æ* or *œ*, it is soft. Good illustrations of the hard and soft sounds of *c* are to be found in our Catalogues of Lepidoptera. Among the *Bombycidae* we find *B. quercus* and *L. quercifolia*; in the former the consonant is hard, because followed by *u*; in the latter soft, because followed by *i*, although the latter name is derived from the former. Other examples of the hard *c* are found in *cassiope* and *conspicuata*, of the soft in *centonalis cytherea*, *urticae* and *Coenonympha*.

The letter *g* is in the same category, and is sounded hard or soft in accordance with the same rules. There are several exceptions to the rule in the English language, when *g* is followed by *e* or *i*, as for example, *get* and *give*; but in Latin there are none—the rule must be observed strictly. Examples of the hard and soft *g* are also numerous, especially among the Rhopalocera. In *galatea*, *aegon* and *exigua*, the *g* is hard; in *agestis*, *crataegi*, *argiolus*, *lithargyria* and *megaera*, it is soft.

These two consonants seem to me to be the chief stumbling-blocks in the pronunciation of Latin, by persons who have not had efficient instruction in the language. Such persons do not seem to realise the fact that when a Latin name is formed from a Greek root, or, as in the name *caeruleocephala*, from a combination of Latin and Greek roots, it becomes *de facto* a Latin word, and that the sound of the Greek consonants is consequently inadmissible. *Lactometer* is the English term for an instrument used in determining the quality of milk; it is derived from the Latin *lac* (milk, and the Greek *metron* (a measure, but it is a purely English word notwithstanding its derivation.

The only other consonant which seems to require notice is *j*. I suppose that if I said there was no *j* in Latin, I should be confronted with proof to the contrary from a Latin dictionary, and should be asked how I got rid of the *j* in *Jupiter* and *Juno*. I, however, must maintain that there is no Latin letter which has the sound of the English *j*, and, in proof of my statement, I produce a school-book called *First Latin Primer*; in the vocabulary at the end of this no words will be found under *j*, and the names which I suggested might be produced to confute me will be found printed *Iupiter*, *Iuno*. in fact, in none of the Latin educational works now being printed for the use of schools, is the letter *j* to be found; *i* being substituted throughout. There is no doubt that the rounded *j* is the modern form of *i*, as *v* is of *u*, both being used indifferently with vowel or consonant power. In the *Century English Dictionary*, the following passage occurs:—"*J* is only another form of *I*, the two forms having formerly been used indifferently, or, *J* preferred when final. In Latin, for example, *i* was written where we write both *i* and *j*, and had, now the vowel value of *i*, and now the consonant value of *j*, being pronounced as *y*, where we now write and pronounce *j*; *e.g.*—*Hallelujah*. As a numeral *j* is a variant form of *i*, used generally at the end of a series of numerals, and now only in medical prescriptions

as *vj*, six, *viij*, eight." The trivial names *caga, baja, bajularia*, are to be found thus spelt in Stainton's *Manual*, Doubleday's *Catalogue*, and Newman's *British Moths*, and accordingly we often hear them pronounced *kaydga, baydga*, and *badgularia*; when we turn to the *Accentuated List*, however, or to South's *Synonymic List*, we find them spelt *caia, baia*, and *baiularia*, and in addition we find, that the same change has taken place with *ianira* and *ianthina*. With regard to *Jupiter* and *Juno*, these are the English names of the Roman deities *Iupiter* and *Iuno*, the *J* taking the sound of the English *Y*.

I trust that I have now succeeded in showing you that the analogy of our own language being the rule for pronouncing Latin, there is not much need for any other directions than such as are given for the pronunciation of English words. The general rules are followed almost without exception, and there is little difficulty until we come to the position of the accent. We have still two points to deal with, *accent* and *quantity*, and both are complex and difficult; I propose to confine myself to a few general remarks on each of the two points, and to offer some practical suggestions.

The word *accent* is not much used now in the classical sense. In modern parlance, *accent* is much the same as *stress* or *emphasis*. If we say that the first syllable of *honest* bears the *accent*, we merely mean that we lay a greater stress on that syllable in pronouncing the word. As a matter of fact, *accent*, in the proper sense of the term, and *stress*, can exist in the same word independently of each other. The same holds good with respect to *quantity*—the length of time during which a vowel sound is prolonged. In Latin, there are no accentual marks to guide us, but the main rules for accentuation are very simple. With some trifling exceptions, every dissyllable has its *accent* on the penultimate, independently of the *quantity* of either syllable; every word of three or more syllables, has the *accent* on the penultimate if the vowel of that syllable be long, on the antepenultimate if the vowel of the penultimate be short.

The other point is *quantity*; in other words, whether the vowel which gives the sound to a syllable is long or short. *Quantity* and *accent* are the two component parts of *Prosody*, but, as this is about the most abstruse part of grammar, I shall not weary you with a dissertation upon it, and it would be manifestly superfluous to suggest a close study of the subject. Let us look at it in a practical manner. The two questions which require solution seem to be:—1. How can an entomologist be apprised of the fact, that it is possible that his pronunciation of a Latin word is wrong, either in *accent* or in *quantity*? 2. How can he ascertain what the correct pronunciation is? I may observe that the first question can hardly arise in connection with the trivial names of any of the Geometræ, Pyralides, Tortrices, or Tineæ, because, all these have a distinguishing affix, the penultimate of which is invariably accentuated; it is, therefore, only in regard to the trivial names of the Rhopalocera, Bombyces, and Noctuæ, and in generic names that error is possible.

When a lepidopterist hears the name of an insect pronounced differently, either as regards *accent* or *quantity*, from the manner to which he has been accustomed, he may safely infer, provided that the word be not a quadrisyllable, that either he or the speaker is in error; it depends a good deal upon whether the hearer is of an enquiring turn

of mind or not, whether, with the ulterior object of being accurate, he endeavours to ascertain which is the correct pronunciation, or does not. If he had a *Lithosia* or a *Sesia* concerning whose identity he had some doubt, he would probably take the earliest opportunity of consulting some trustworthy book or cabinet, with a view to the resolution of his doubt. I would suggest that, in the case of a doubt about *accent* or *quantity*, the *Accentuated List* should take the place of the cabinet. Two editions of this work are published, one costing only three-pence, and containing only the names, with indication of their *accent* and *quantity*; the other, costing five shillings, and containing in addition, some account of the derivations of the names, with the reasons, where practicable, for the application of such names. Looking at the derivations as a whole, we do not find that they assist the student of pronunciation to the extent that might have been expected; the cheap edition of the *List* is quite sufficient to furnish the enquirer with all that he needs to know, in order to accent and pronounce classical names correctly.

In conclusion, while it is too much to hope that our elders will abandon any errors into which they may have fallen, I would appeal to young entomologists to make an attempt to cope with this somewhat difficult matter, and to surmount it. I venture to think that it would be difficult to find anyone who would maintain that correctness of pronunciation and accent is immaterial, even in private, for is there not the possibility of the propagation of errors, especially among the rising generation? We are all, however, in the habit of exhibiting our captures in a quasi-public manner, and this necessitates the airing of our Latin pronunciation in public; and I think it will be generally admitted that every effort should be made, not only to avoid errors, but to attain accuracy as far as possible.

February 6th, 1894.—Exhibits: Mr. Battley; the jaw-bones of a fish called the Thornback Ray, which feeds on crabs, &c.; the bones were each provided with a set of flattened, tooth-like plates, which slightly overlapped and seemed to be of very hard material. He also showed a spine of the same fish, and called the attention of the members to the fact that this spine was hollow and very hard. Mr. Clark; *Biston hirtaria, Lobophora lobulata, Zygaena trifolii* (a yellow var,) and *Abraxas grossulariata* (dark var.), all from Perth. He also exhibited, at Mr. Tutt's request, the fine series of *Argynnis paphia*, taken in the New Forest last year. In consequence of some remarks by Mr. Frohawk (*Entomologist*, Feb. 1894) relative to these specimens, the opinion of the meeting was taken as to whether any of the *male* specimens showed traces of greenish coloration; the members were unanimous that such was the case with two of the males. The whole series consisted of twenty-four butterflies, of which the spotted specimens were as follows: Six males with straw-coloured spots, two of them having also *distinct greenish blotches* on the hind wings; six females with greenish blotches, two of them having also bleached-looking markings on the fore-wings. Mr. Prout; *Mamestra sordida* (*anceps*) bred last January. He stated that he found this larva at Culver Down, Isle of Wight, feeding on grass at night; it strongly resembled the larva of *Apamea basilinea*; as it seemed disposed to hybernate, he kept it feeding in a warm room, with the result that it pupated in December. He also showed a specimen of *A. basilinea* reared under somewhat similar conditions in 1892. He

was inclined to think that *sordida* should be removed from the genus *Mamestra* and placed before *Apamea gemina, A. unanimis* and *A. basilinea,* as in Kirby's "European Butterflies and Moths," with which insects he considered it had more affinities than with the genus *Mamestra.* Mr. Bacot; ova of *Nyssia hispidaria,* laid in captivity. Dr. Buckell remarked that they very much resembled those of its ally *Amphidasys betularia.*

Mr. Bayne, who exhibited a good series of the insect, which included brown, greenish, light grey, melanic and white-margined forms of the ♂ and green and brown forms of the ♀, then read the following paper:—

NOTES ON NYSSIA HISPIDARIA.

On February 1st, 1893, two apterous ♀s emerged in my breeding cage from pupæ dug in Epping Forest in the late autumn of 1892. The preceding week or ten days had been very mild for the time of year. *Phigalia pedaria* (*pilosaria*) had been observed in the open on January 22nd and eight *Hybernia defoliaria* had been bred indoors between the 25th and 29th of that month. Of course, as these ♀s were certainly not *P. pedaria,* they were at once noted as *Nyssia hispidaria* and Feb. 5th being fine and bright, was devoted to searching for this species, the said search being rewarded, after five hours, by a single ♂ taken on a "spear" oak. *Hybernia marginaria (progemmaria),* both sexes, and *Anisopteryx aescularia* put in a first appearance on the same day. The emergence of two ♂s and a ♀ *N. hispidaria* during the night of Feb. 7th, which was warm, gave the impression that there was a possibility that the species might be found more commonly than is usual in the Forest, where three years' searching had resulted in the discovery of about ·75 of a male. The next expedition, on the 12th of the same month, was, however, hardly a success; the wind was fresh, in fact blew a gale from the N.W., the weather was dull with passing showers of hail and rain, and the shade temperature ranged (in London) from 44° to 34°. Only one crippled ♂ and a ♀ with five legs turned up, and Lepidoptera generally were very scarce. The morning of Feb. 19th however, had a very different aspect; the wind was S.E., light, and during the day the temperature ranged from 59° to 46°; a shower fell about 9 a.m.; the weather was splendid for February—mild with bright sunshine, and the clan turned out in force for a grand effort. The first *hispidaria* was quickly found, and before many trees had been searched, it became evident that the moth was in overwhelming abundance. At 10.30 many were seen drying their wings and some with wings quite unexpanded. The general time for emergence seems to be from early morning to about 2 p.m. The height at which they usually sat was four to five feet, but a fair proportion were very much higher. Some were running rapidly up the trunks, while one or two were resting, apparently unconcernedly, with the sun shining brightly upon them. They press themselves very closely into crevices in the bark and are not by any means easy to find. Individuals were noticed on hornbeam, beech, &c. as well as on oak, and even on trailing creepers. Very few cripples were met with. The species must, so one would expect from the apterous condition of the ♀ and the structure of the antennæ in the ♂, assemble, and it was remarked that where a ♀ was discovered, one male, if not more, was practically certain to be on the same trunk.

To give an idea of the abundance of the insect on this day, I may say that in one favoured spot thirteen were resting on a large oak—nine ♂s and four ♀s. The other spring insects were seen on the same day but were none of them present in more than their usual numbers. On the 25th no searching was done—the entry in the diary reads simply thus: "Went to Chingford, weather awful, swore, and went home." On the 27th a single ♀ emerged indoors. On March 5th a good deal of ground was covered and about a score of specimens turned up; the morning was fine but the sky clouded over gradually as the day went on; the weather was mild, wind N.W. but sport generally was not very good. On the 12th of the same month two ♂s and one ♀ were noticed and the season, so far as this species was concerned, closed at 12.30 on March 26th with the capture of a single ♂ drying its wings. Thus a period of seven weeks had elapsed since the first appearance.

The insect is, I should think, an easy one to pair in captivity. I placed a ♂, which had been out a day or two, with a freshly emerged ♀, in a fairly large wooden box, on Feb. 8th, but, though I looked at them morning and evening, I did not witness the pairing; however, on the 11th, the ♀ deposited a number of fertile ova.

I have never seen the male in the act of flying spontaneously, but we caused several to take the air by throwing them up. These flew rapidly and turned very sharply—darting forward and doubling back suddenly, so that they would be difficult to catch on the wing.

In considering the possible causes of this abnormal abundance of the species in 1893, I will first deal with an important factor in the situation—the weather, beginning at the point when we commenced our search for the species, February, 1890. In 1890 one imago was found. Spring probably moderately favourable for larvæ. In 1890-91, winter unusually rigorous; 1891, February very favourable for appearance of imago, none however found; March, April, and May cold, spring very backward, and perhaps unfavourable to larvæ; 1891-92, winter again severe; 1892, spring rather favourable to larvæ; October, a wet month; November fairly dry, temperature average; December dry, the first week cold, with low night temperature; then a fortnight of warm weather; the last week exceedingly cold, 17 to 18 degrees of frost; 1893, January, rather dry but cold, especially the early part of the month; February, a wet month, with temperature above the average; March, April, and May, extremely dry; larvæ (I am told) plentiful. The probable effect of the cold winters of 1890-91 and 1891-92, would be to keep down the depredations of the moles, mice, beetles, earwigs, &c., by extending the length of time which they spend in a state of torpidity, and possibly to reduce the numbers of these enemies to pupæ. No imagines were found by us in either 1891 or 1892, though February of the first-named year appeared to be eminently suited for emergence, but the cold dreary spring months of 1891 may have checked any increase by retarding or stopping the due development of the larvæ. I am sorry, however, that I am unable to speak as to the frequent occurrence or otherwise of the larvæ in those years, for this would give a truer idea of the relative abundance; searching for the imago being often obstructed by the available days happening to be cold or wet. I do not know whether the heavy rainfall of October, 1892, may have favoured the pupæ. Are they liable to dry up? As they usually, I believe, bury themselves to a depth of several inches, moisture, dryness

or cold would not be so likely to affect them, as would be the case with pupæ lying nearer the surface. Many, however, do not inter themselves so deeply, as we have found pupæ just under the roots of the grass. Any advantage, too, gained by a very wet and mild season, would probably be more than counterbalanced by the extra activity of the mole, and other lovers of fat pupæ.

Some other ideas suggest themselves. Immigration can scarcely be an important factor in a species with a wingless ♀. It has, indeed, been supposed, that a reinforcement of ♂s might increase the fertility of a species, but it seems unlikely that *hispidaria* should have benefitted in this way, although, from its robust appearance, a long flight would appear quite possible. The sudden augmentation of numbers, it will be noticed, took place in a well-known locality, where the insect is found in greater or less numbers, (generally the latter) every year. An alteration in the fertility or irregular fertility of a species in different seasons, has been suggested, but I do not know whether there are any facts in support of this theory recorded in relation to the macro-lepidoptera. It might be that an unfavourable change in the weather might retard oviposition by the ♀, or even destroy her, and this may possibly exert a certain influence in some seasons. The day on which we found the single ♂ in 1890, was an example of such a change, the afternoon turning very cold, snow and hail falling fast, and being driven by a strong N.W. wind into the crevices of the bark. I have been told by friends who have reared the species, that the larva is very subject to the attacks of *Ichneumonidae*, *Tachinidae*, etc., but we know so little as to the relative abundance or scarcity of these parasites, that their influence must, I am afraid, remain an undetermined factor.

Hispidaria is, I am given to understand, a very prolific insect, but it seems no marvel, when we consider the perils through which it has to pass, that so few reach maturity. The ova have to withstand the attacks of tits, creepers, spiders, &c.—By the way, the *Paridae* seem to find the forest tree-trunks a prime feeding ground in the winter months; they rove through the woods in large flocks.—The larvæ have to run the gauntlet of the inclemency of our springs, of *Ichneumonidae*, *Tachinidae*, birds, and other enemies; the pupæ are beloved by the mole; the imago emerges in a month so cheerless as is our customary February, and in a very dry or frosty season might even be unable to reach the surface. Our friends (or enemies) the tits may often be observed during the winter months searching on the ground and about the roots of the trees, and no doubt many a ♀ falls to their lot. But the prolificness of the species would render probable its appearance in unusual numbers, whenever the attentions of its numerous enemies was in any degree relaxed, or meteorological conditions were unusually favourable. It may be interesting to note in passing that another moth, *Taeniocampa munda*, was much more abundant than usual in the early part of 1893. Since 1890, this moth has been far from common, but last spring it might have been captured by hundreds at the sallows. Its larva feeds on oak, and undergoes pupation at the base of the tree, favouring similar situations to *N. hispidaria*. I fear, however, that we cannot arrive at any very definite conclusions as to the causes of the phenomenal abundance of the last-named species last year. The only really determinable among the, perhaps, many determining causes, appears to be the favourable spring of 1892 for the development of the larvæ, and

the equally favourable February of 1893, for the emergence of the perfect insect.

Hispidaria is a *Vienna Catalogue* name but, as that work contains no description of the insect, we take the following, made from Schiffermüller's specimens by Fabricius (*Mant. Insect.*, ii, p. 191, no. 59), as the type. "*Phalaena* pectinicornis alis cinereo-fuscis: striga undata obscuriore, margine alba punctato, antennis flavis. Nimis affinis *P. hirtariae* at paullo minor. Corpus hirtum griseo-fuscum. Antennæ flavæ. Alæ obscuræ striga media undata obscuriore. Margo albo punctatus." Hübner (*Samml. europ. Schmett.*, iv., fig. 177), figures the insect as pale brown (not greenish), the fore wings with three and the hind wings with two transverse lines. Hind wings, pale; outer margin of fore wings, yellowish-white. Treitschke (*Schmet. v. Europ.*, vi., 1, 247), seems to have been the first author to mention the ♀ ; to a diagnosis similar to that of Fabricius he adds "fœmina aptera." Duponchel (*Hist. Nat.*, vii., 154, 3), describes the fore wings as being of a rather dark bistre, with a band of a clearer tint at the outer margin, traversed by three blackish diverging lines, of which two are curved and the third is sinuous and toothed; and the hind wings as being pale bistre, with two blackish lines, one being faintly marked. The figures agree well with this description. Herrich-Schaeffer, in 1844 (*Syst. Bearbeit.*, iii, fig. 14), figures the ♀ .

Turning now to British authors :—Donovan (*Brit. Insects*, xiii, pl. 447), in 1808, figures and minutely describes the species under the name of *Phalaena ursularia* (the thick-haired moth). Both sexes are said to be represented in the plate, but the figures are all of males. Donovan would have referred it to the Bombyces "without scruple . . . . but for the authority of Mr. Drury, who was so fortunate as to rear it from the caterpillar, and which, being of the looper kind, decidedly proves it to be of the Geometræ, instead of Bombyx family." Donovan thought the specimens bred from these larvæ and preserved in Drury's cabinet (which Donovan possessed) were unique. It seems rather curious that he should have thus re-named the insect, as he was acquainted with the *Mantissa*, and especially as he says "our present insect has some resemblance . . to the sp. *hirtaria*, but is smaller," while Fabricius writes "Nimis affinis *P. hirtariae* at paullo minor." Newman, in the *Entomological Magazine* for 1833 (vol. i, 413), described the pale form as a new species, under the name of *Nyssia tauaria*. His description is as follows:— "Fusco grisea, metathoracis margine anteriori, lineaque centrali longitudinali nigris, ♂," and he mentions as specific characters by which to distinguish it from *hispidaria* and *pilosaria*, "its superiority in size to the former of these ; the T on the mesothorax, formed by the transverse and longitudinal black lines ; the broad pale margins of the front wings, and lastly, the fact that the specimen emerged at such a different time of the year from other members of the genus (which, Guenée states, all appear in March, or earlier), it having been taken by Newman's father, in June, 1832, at Leominster, in a perfectly recent state, and had apparently never flown."

Wood (*Index Entomologicus*, fig. 1675) figures this specimen as *Nyssia tauaria*, but there is a note by Westwood, "*hispidaria* var." Wood gives reference to *Entom. Mag.* and to Stephens (*Ill. Haust.*, iv., p. 391). He also delineated *hispidaria* (No. 466), his figure being of a dirty brownish-grey colour, the inner margin clouded with a darker shade,

the outer margin pale and the transverse lines indistinct. Guenée (*Hist. Nat. des Insectes., Geom.* i., 202) referring to the *tauaria* of Newman, as figured by Wood, says "it does not appear to me even a variety. It is a fairly good figure of the type, whilst No. 466 is inexact and much too dark." He adds that he had, however, received from England "an individual much more sombre than the French form." Newman in his *British Moths* omits all mention of *tauaria*, but gives a very good description of our usual form of *hispidaria*.

The varieties of *Nyssia hispidaria* may be roughly classified as follows:—(*a*) Pale greenish-grey, lines distinct: (*b*) pale reddish-brown, lines distinct (Hb. 177): (*c*) ashy-brown, with darker band; this may be divided into two sub-varieties (*c*1) ashy, with a brownish tendency (the type) and (*c*2) ashy, with a greenish tendency: (*d*) similar to the type, but with the outer margin of fore-wings nearly white: (*e*) melanic. The first form might well be called var. *tauaria*, Newm., though it does not always show plainly the black T on the meso-thorax. This is the form to which Guenée refers as the type. Examples of this pale form are, according to our experience, rare; their proportion being about 2 or 3 per cent. I have seen no specimens that agree with Hübner's figure, though it seems probable that such exist. It would have a similar relation to *tauaria* to that which the ashy-brown type has to the greyer sub-variety. The form with the pale outer margin is also, unfortunately, far from common; it is perhaps the most beautiful form of the species; in the specimen which I exhibit it will be noticed that the pale band is continued across the hind-wings, dividing these into a dark basal area and an outer nearly white area. Melanic specimens are likewise scarce; they usually show traces of the outer marginal band. I exhibit also a few other variations; two specimens show a tendency to the development of a solid black median band; another is a very dull brown diffused example; a third is more thinly scaled than usual. The decidedly paler and more clearly marked character of Continental (especially French) specimens is very evident, both from the figures of Hübner and Duponchel and from the remarks of Guenée. The figures, too, represent the insect as having two lines across the hind-wings; I have no specimens in which these are present but, in a few, there are slight indications of them. The great majority of my examples from Epping Forest are typical, sombre-looking and indistinctly marked.

And now a few words about the ♀. As has been more than once pointed out, there is a pale greenish-grey form and a dark reddish-black form. It is most easily distinguished from the female of *P. pedaria* by the legs, which are nearly smooth in *pedaria* but very hairy (at least the basal joints are) in *hispidaria*. The antennæ of the latter, too, are more pectinated and she is stouter structurally.

Guenée writing of the genus *Nyssia*, Dup. remarks on the strong build and hairiness of the thorax, the semi-transparency of the wings in the ♂ (this transparency is rather noticeable in some examples of *hispidaria*) and the apterous character of the ♀s. He states that all the species are more or less rare; and that he knew only European species. Guenée divided the genus into two groups—the first having the rings of the abdomen in the ♀s adorned by circles of colours often rather bright. This first group includes our *zonaria*, *lapponaria* and *hispidaria* belonging to the second. Our two species (omitting *lapponaria*, of which I know nothing) differ widely in form and in habits,

hispidaria resting on tree trunks and its coloration assimilating itself to the trees on which it rests, while *zonaria* frequents sandhills, its coloration protecting it among the grasses, &c. of its habitat.

Dr. Buckell remarked that the *Amphidasydae* consisted so far as this country was concerned of six species, three of which had apterous females and the other three females with fully-developed wings. He did not know whether there were any Continental species which occupied an intermediate position as regarded this characteristic.

Mr. Tutt, in rising to propose a vote of thanks to Mr. Bayne, congratulated him on the interesting paper he had furnished, and then went on to say that he quite agreed with Mr. Bayne on the improbability of *hispidaria* having been affected by immigration, although it was remarkable how widely distributed some species with apterous females were, and the males of two species with apterous females, *Hybernia defoliaria* and *H. aurantiaria* were known to migrate. The abundance he considered due to local causes, one important feature that struck him being that the previous year the oaks had been less defoliated than usual by the ravages of *Tortrix viridana*, and it was remarkable that *Taeniocampa munda*, another oak feeder, was abundant the same year. The effect of the utter defoliation of the oak trees in some years must often act detrimentally on other larvæ which are feeding at the time, and of these *Nyssia hispidaria* would suffer greatly. It was an off-hand suggestion certainly but seemed probable.

Mr. Bacot, who seconded the vote of thanks, observed that he understood that pupæ had been dug in considerable numbers during the past winter, and that the imagines emerging from these had been in the proportion of twelve or fifteen females to one male. From fifty pupæ which he had received from Epping Forest he had not, as yet, bred a single male. Thinking it probable that "assembling" would occur, he, on February 3rd, took six or seven females to Chingford and placed them in a small gauze cage about five feet from the ground. The evening was favourable, warm and windy though clear. The first ♂ turned up at about 6.45; others followed, in twos and threes at first but afterwards singly and at longer intervals until 7.30, when the last was captured. The total "bag" was seventeen and one or two others were missed. Mr. Bacot watched the cage in order to try and get a sight of the males as they came up, but it was too dark to see them until they were quite close; their flight then seemed to be very rapid and their buzzing against the cage audible some feet away; two of them flew against his face and the blow was more like that given by a beetle than by a moth. On reaching home two males were put into the cage with the females; they copulated about 10.30 but only remained in copulation about fifteen minutes, herein differing from *Biston hirtaria* and *Amphidasys betularia*, which remain joined for some hours. After separation the two males and the virgin females were removed to separate chip boxes for the night; the next evening the males began to get restive about 6.30, and were placed in the cage with the females that had not commenced to lay, to which were added two that had emerged that morning. One of the males, a rather large one with a piece torn out of one of his fore-wings, went in copulation within a few minutes and the pair remained together about fifteen minutes; after they had separated the ♀ was removed and shortly afterwards the same ♂ was found in copulation with another ♀. Mr.

Bacot kept this last ♀ apart from the rest, in order that special note might be taken as to whether her ova prove fertile or not, it having been the third time that same ♂ had paired within twenty-four hours. Mr. Bacot thinks that there is probably a second flight, as the males in his cage again began to get lively about 10.30 to 11 p.m.

Mr. Prout considered it probable that the abundance of *N. hispidaria* in 1893, was due rather to meteorological or local causes, than to immigration. He had done a good deal of larva-beating during the last few years, at the spot where Mr. Bayne found the moths most abundant, and the larva seem to have been steadily increasing in numbers, having been specially plentiful in 1892. The larva is not exclusively an oak feeder; it will thrive well on hawthorn, and hornbeam. As hawthorn is obtainable at least a month earlier than oak, a knowledge of its being accepted by the larvæ may be useful to those breeding the species from ova. Mr. Prout was disposed to doubt whether it was safe to assume that the coloration of figures, even of those of Hübner, was always accurate. He had long thought that there must be some kind of connection between winter emergence and the occurrence of apterous females, *Orgyia*, etc., being merely casual exceptions due to some different cause. It was certainly interesting to note that in the *Amphidasydae*, the earliest species have apterous females, while those that emerge later on are winged in both sexes, the solitary summer species, *A. betularia*, alone having the wings of the ♀ really well-developed.

Mr. Clark mentioned birch as another plant on which the larvæ readily feed, and remarked that, in pupating, the larva frequently descends as much as eighteen inches below the surface of the ground.

Feb. 20th, 1894.—Mr. Heasler having sent in his resignation of the curatorship, Mr. Bayne was unanimously elected in his stead.

Exhibits:—Mr. Battley; ova of *Diloba caeruleocephala*. Mr. Clark; a short series of *Gnophria rubricollis* from the New Forest, and a curious pad of felt-like material, resembling a pancake in appearance; this had been spun in a pill-box by parasitic larvæ, which emerged from a larva of *Hepialus humuli*; the disintegrated remains of the latter were attached to the pad. Dr. Sequeira; the following "Micros" from the New Forest:—*Crambus perlellus*, var. *warringtonellus*, *Harpipteryx xylostella* (*harpella*), *Cerostoma radiatella*, *Retinia pinicolana*, *Eupoecilia ambiguella*, *Paedisca solandriana* and *P. profundana*. There were six specimens of the latter species, three of them having an inner-marginal white spot on the fore wings, and the other three no white spot, but a distinct oblique dark fascia, which gave them a strong resemblance to the genus *Tortrix*. Mr. Lane; *Stauropus fagi* and *Lasiocampa quercifolia* from Reading. Mr. Bayne; *Hybernia defoliaria* from Epping Forest; most of these were of the pale cream variety, with dark bars.

March 6th, 1894.—Exhibits: Mr. Oldham; a short but very variable series of *Hybernia leucophearia* from Epping Forest. Mr. Clark; some freshly emerged specimens of *Taeniocampa gothica*, reared from eggs of var. *gothicina*; the specimens were richly suffused with red but were in other respects of the normal type. Dr. Sequeira; the Indian form of *Vanessa atalanta* and *V. cardui*, which did not appreciably differ from those found in this country; also a sort of spur from the thorax of *Dicranura vinula* with which, he stated, the moth cut its way

out of the cocoon. Mr. Bayne; four eggs of the Willow Wren (*Phylloscopus trochilus*), two of which were rather long and speckled with very small reddish dots, while the other two were roundish and marked with reddish blotches. Mr. Battley reported that he had recently taken *Nyssia hispidaria* in Epping Forest by "assembling"; on a frosty evening he secured about 20 males, but on a warm evening nearly 70 rewarded his exertions; he also stated that he had found a ♂ *Hybernia marginaria* paired with a ♀ *Phigalia pedaria* and that he had obtained ova from the latter. Mr. Tutt, in connection with an exhibit of some South African flowers and of insects caught by them which had been sent to Mr. Hope Alderson of Farnborough, said that the local name of the plant is the "moth-catcher" and that the flowers close on any insect settling on them and hold it fast till it dies. Mr. Alderson hoped to receive some seed of the plant, which he would try and rear. Mr. Tutt also passed round an auctioneer's catalogue of a sale of the Duchess of Portland's collection in 1786. Mr. Bacot exhibited pupa-cases of *Saturnia pavonia, Bombyx quercus, Odonestis potatoria, Dasychira pudibunda* and *Ocneria dispar*, and made the following remarks:—"It occurred to me that, as many apterous ♀s have the wing-cases well-developed in the pupa, possibly the ♀s of other species might have specially male characters developed in the pupa. An examination of the pupa-cases of the species exhibited to-night yielded the following results: In *S. pavonia, D. pudibunda* and *O. dispar* the antennæ-cases are nearly as well developed in the female as in the male pupa, whilst in the imagines the antennæ are only very slightly pectinated in the ♀ and only occupy a small portion of the space covered by the pupal cases. In *B. quercus* there is no development suggestive of pectinated antennæ in the pupa, though the antennæ-cases are rather more raised in the male than in the female pupa; in *O. potatoria* the development is hardly noticeable; in the imagines of both species the pectinations are strongly marked in the ♂s, slightly so in the ♀s, the latter species being rather the more favoured in this respect. From these facts I am inclined to think that the first group have evolved from a type or types that had the pectinations of the antennæ well-developed in both sexes and in which, probably, either sex would be attracted by and fly to the other, that the ♀s subsequently lost the pectinations through disuse, whilst in the ♂s of *S. pavonia* they have been still further developed. In the second group the evolution would seem to have been from simple to pectinated antennæ, the ♂s having advanced farthest in this respect, whilst the pupæ have not yet fully responded to the change." Mr. Routledge exhibited a collection of Coleoptera taken by him near Carlisle, among them being *Silpha nigrita, Coccinella* 14-*punctata, Pterostichus versicolor, Amara ovata, Limonius cylindricus* and *Barynotus schönherri*. Mr. Tutt read a paper on "Nature's Scents," in which he pointed out that, as a rule, it was the inconspicuous flowers which had the richest perfume, blue and red flowers being mostly devoid of odour; that this development of perfume subserved the purpose of attracting insects to the blossoms and so ensured cross-fertilization; other scents, both in the animal and vegetable kingdom, were disgusting and probably subserved a protective function. Mr. J. A. Skertchley mentioned the case of a South American flower which was of a deep red colour; it was perfectly scentless by day but during the night, when its colour rendered it practically

invisible, it gave off a very powerful perfume; the plant was visited in large numbers by a species of a Hawk-moth.

March, 20th, 1894.—Exhibits:—Mr. Prout; a large number of specimens of *Coremia ferrugaria,* Haw., to illustrate his paper. Mr. Battley; a living ♀ and ova of *Anisopteryx aescularia, in situ,* on a twig of birch; the eggs were deposited in a necklace-like ring, encircling the twig just beyond a small shoot; there were about 24 eggs, counting round the twig, and the band varied from 4 to 9 eggs in width, so that in all there were 150-200 eggs. They were covered with down from the anal tuft, and appeared to be ovoid in shape, and attached by their smaller end. Dr. Sequeira; *Amphidasys strataria, Panolis piniperda, Hybernia leucophearia, Aleucis pictaria,* all bred, from the New Forest; also several beautiful varieties of *Larentia caesiata, Melanippe montanata, Melanthia albicillata,* and *M. bicolorata.* Mr. Goldthwait; *Colias edusa,* with var. *helice,* and intermediate forms; one of the *C. edusa* had the marginal pale spots so strongly developed on the hind wings, as almost to form a band. Mr. Lane; *Calocampa vetusta* from Aberdeen. Mr. C. Fenn; *C. ferrugata* and *C. unidentaria,* including a Scotch form of the latter, and a specimen with the median band extremely narrow. These two species were also exhibited by other members. Mr. Bayne exhibited *Psilura monacha* from the New Forest, and made the following remarks:—"This species seem to have shown—at least in our experience—a greater tendency to the production of banded forms in 1893, than in the preceding season; and the more frequent occurrence of dark varieties in certain seasons has previously been commented on by Mr. Tutt. At least five, including examples of both sexes, of those captured in 1893, show this condition, and one ♀ in particular has an almost solid black median band across the fore wings. It will be noticed, too, that this specimen is much below the normal size. Now, amongst those taken in 1892, only one or two show a deviation from the type in that direction, and the deviation is slight. All those exhibited were taken either as imagines or as pupæ. In 1893, the larvæ were subjected to the long drought which had been almost total for four months previous to the appearance of the perfect insect. They must also have experienced, both as larvæ and pupæ, great alternations of temperature—hot sunny days and cold nights. The date of appearance varies considerably in different years; in 1892 and 1893, the species was well out at the end of June, whilst in 1891, several fresh examples were taken at the beginning of September. The ♀ appears to be very weak winged—a condition which seems often to obtain in families containing species with apterous ♀s."—Mr. Smith said that he had bred *Amphidasys strataria* on the 18th inst. from New Forest larva. Mr. Battley reported that *Brephos parthenias* was just coming out at Theydon, and that *Asphalia flavicornis* was getting worn. He had also found *Taeniocampa munda* common, and *T. cruda* swarming on the sallows in the same locality, and had taken one *T. populeti.*

Mr. Prout then read a paper on

COREMIA FERRUGARIA, Haw. and UNIDENTARIA, Haw.

Probably most of the members of the City of London Entomological Society are by this time aware of the fact, that I have for some years

past been taking a deep interest in the Geometrid moths known in this country, after Haworth, as *Coremia ferrugata* (or *ferrugaria*) and *unidentaria.**

All through the history of entomological nomenclature there has been a recurring tendency, on account of their great superficial similarity, to unite these two as one species, and it was the desire to obtain independent evidence on the question of the identity or distinctness, by breeding both forms from the egg, which first led me into the study of them. Being at that time quite a novice in entomology, I was unaware of the careful breeding experiments of Messrs. C. Fenn, Sydney Webb, and others, including our own member Mr. Boden, but even had it been otherwise, there was the conflicting statement in Newman's "British Moths," that Sepp had "figured both varieties as bred from the same caterpillar" (or, as it should perhaps be stated, "from the same batch of eggs"), and also the experience of so excellent an observer as Mr. Nelson M. Richardson, that he had obtained one form from eggs of the other; from which it was evident that further investigation was required.

After breeding each species several times, and having the good fortune to abundantly verify Newman's statement that "*Coremia unidentaria* occasionally has a purple-red median band, very much resembling that of *C. ferrugata*"—a fortune which has not yet attended Messrs. Fenn and Webb, in their far greater experience, and communicating with several entomologists who had information to impart on the subject, I wrote a somewhat tentative article, which appeared in the *Ent. Rec.* of July, 1892 (vol. iii., p. 150). My own personal opinion was at that time, what has since been proved correct, that we had two quite distinct species to deal with, and that the seeming contradictions were to be reconciled through the existence of a red form of *unidentaria*, Haw. so like *ferrugaria*, Haw. as readily to be mistaken for that species. It is, indeed, somewhat surprising, that so much uncertainty and confusion still prevail; for I find that Doubleday, 30 years ago, knew pretty well as much about the state of the case as any of us know to-day. This is proved by Newman's note in the *Entomologist* for 1864-5 (vol. ii., p. 19), as well as by the material our great entomologist has left behind him in his collections. Dr. Knaggs (*Ent. Ann.*, 1865, p. 100), also writes that "Mr. Doubleday has pointed out to me excellent and constant distinctive characters which exist in the hind wings of the perfect insects; thus in *C. ferrugata*, the hind wings present a more or less mottled appearance from greater contrast between the ground colour and markings, while in *C. unidentaria* they have a confused, somewhat unicolorous look: the darkest shading of the hind wing in *C. ferrugata*, is at the hind margin, which is, as it were, deeply bordered, but in *C. unidentaria*, on the contrary, the *base* of the hind wing is the most darkly shaded part—the transverse lineations across the middle are much more strongly marked in *C. ferrugata* than in *unidentaria*, &c., &c."

"The above distinctions between these species hold good, even when specimens closely approximating in colour are opposed, *so that this question may now be looked upon as settled.*" The closing italics are mine;

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* Throughout this paper except in dealing with variation, I have called the species by Haworth's names, by which they are universally known to British entomologists.

truly, as Mr. Sydney Webb remarks, "it is curious how history repeats itself."

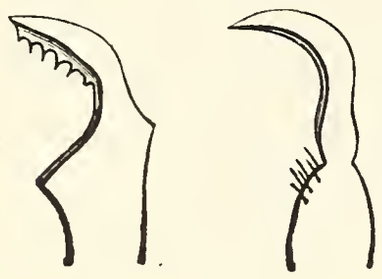
As one of my principal objects in preparing this paper is to bring before your notice and that of entomologists generally, the absolutely certain fact of the distinctness of the two, and the equally certain fact of the existence of red forms of *unidentaria*, Haw., and thus to leave no possible excuse for going over the same ground again in the future history of entomology, my first point must be to demonstrate their structural distinctness, after which I shall group my other remarks under the following heads—Synonymy, Differentiation by Wing-markings, Variation, Geographical Distribution, Habits, Early Stages.

Structural characteristics.—With regard to structural distinctness, my article in the *Record*, referred to above, called forth a response from that careful and accurate observer, Mr. F. N. Pierce, to the effect that the male genitalia differed more widely even than might have been expected in two such close allies, and in the *Record*, vol. iii., p. 177, he gave rough figures of the forms of the "harpes," in each of the two, though unfortunately the names were reversed in the appended note. If members possessing copies have not yet corrected them, may I suggest that they should do so to avoid confusion. As an artificial aid to memory for those who desire to recollect which form of structure belongs to which species, I would point out that the species we are accustomed to call "*unidentaria*," is that in which the harpes are strongly *dentated*.

Thanks to the great kindness of Mr. Pierce, who stands prominent among the many entomologists who have rendered me willing assistance, a number of specimens have been investigated from this point of view, and he has further obligingly sent me his preparations for study and for exhibition this evening, so that I hope to be able to convince the most sceptical of the invariability of the form of the genitalia, and the consequent confirmation of the view arrived at by breeding and by superficial comparisons.

The course which we followed was this:—First, I detached the abdomina of ten of my most disputable specimens (recognizable in my cases this evening by the absence of those parts, and by the reference numbers attached), and sent them to Mr. Pierce in separate boxes, with numbers corresponding to those which I at the same time pinned on to the specimens, *but without giving him any clue as to the identity of the specimens*. He then mounted the portions on which he relies for the differentiation, and wrote me that "Nos. 2, 4, 5, 7, 8, are typical *unidentaria* (as we know it)" and so on. I will quote a short portion of his letter:—"In making so many preparations, I am much struck with the uniformity of size of the whole apparatus; the length in *ferrugata* is in each instance about one-third larger than in *unidentaria*, and this appears quite constant in what I have examined. . . . . In the 14 *unidentaria* and 10 *ferrugata* that I have mounted, I find no trace of the one at all approaching the other; the tooth-like projections which are always strongly present in *unidentaria*, are always quite absent in *ferrugata*; this is, of course, in addition to the parts being differently shaped, in fact, they are as easy to separate as the antennæ of male and female *Bombyx quercus*." I was gratified to find from Mr. Pierce's determination that I had correctly named every specimen, though, as will be seen, some are worn captured specimens, and I had not felt very great confidence in myself in one or two cases. I then sent the specimens

themselves to Mr. Pierce for inspection, and he also was able to separate them from their scale markings, etc.; he thinks he was guided chiefly by the attenuation of the central fascia of *unidentaria* on the inner margin (mentioned by both Haworth and Stephens in their diagnoses, though unfortunately not very constant). I am indebted to the kindness of Messrs. Battley, Nicholson and Jackson in lending microscopes for this evening, and I trust you will all avail yourselves of the opportunity of verifying Mr. Pierce's observations on the genitalia. It may be of interest to mention that Aurivillius in his new work on the Scandinavian lepidoptera (*Nordens Fjärilar*, 1891) also differentiates *ferrugata* and *unidentaria* in this way.



C. unidentaria. C. ferrugaria.

My attention has also been called to one other structural difference, and that is in the matter of scale structure, which has been so zealously and with such interesting results taken in hand by Dr. W. S. Riding. He has rendered me most willing assistance in examining specimens and tabulating the results as regards the proportion of scales with different numbers of teeth, and I am pleased to be able to hand round, for the inspection of those who may desire to look into them, his very carefully prepared tables. He suggested that I should also ask other friends to work independently of him with a view to verifying his results; and I found in my kind friends, Messrs. A. U. Battley and A. Bacot, very ready assistants.

Without going very fully into details, the general result of investigations along these lines, by Dr. Riding and Messrs. A. U. Battley and A. Bacot, seems to be that however much the scale structure of individuals of a species may vary *inter se*, yet *ferrugaria*, Haw. has always a considerably larger number of many-teethed scales than *unidentaria*.

Of 10 *ferrugaria* examined, two showed no 3-toothed scales, while of 11 *unidentaria* three or four showed no 6-toothed, two none even 5-toothed, and none any with *more* than six teeth, while several *ferrugaria* had some 7-toothed scales, and one an odd 8-toothed. To sum up, *ferrugaria* gave 43 per cent. of scales with 2, 3 or 4 teeth, and 57 per cent. with 5, 6 or 7; while in *unidentaria* 82·6 per cent. had but 2, 3 or 4 teeth, only 17·4 per cent. having 5 or 6, the percentage of 6-toothed, indeed, being but ·2.

Mr. Bacot also called my attention to a large number of toothless scales in one or two specimens, these appearing to be non-pigmental.

Mr. Battley further remarks (*in litt.*, Feb. 26th, 1894), that "there is also a decided difference in shape; *ferrugata* has the teeth pointed and generally distinct, the centre teeth being almost invariably longest, and projecting beyond the others; *unidentaria* has the notches between the teeth rounded, the teeth less distinct, and the centre teeth generally further back than the outside ones. The scales of *ferrugata* look much more jagged than those of *unidentaria*." I shall hope to pursue this subject further at some future time, as I have already some very interesting notes and observations from the gentlemen whom I have mentioned. But I introduced the subject here in order to throw a little additional light on the specific distinctness of the two insects, and need only add that a purple variety of *unidentaria* examined by Dr. Riding agreed with the black forms.

Synonymy.—Since then, we have two perfectly distinct species to deal with, the next question which arises is the very difficult one of their synonymy. When I tell you with regard to the two red forms which cause all our trouble, that in Germany and America, our red *unidentaria* is known as *ferrugata*, and in Scandinavia as var. (or ab.) *corculata*, while in Germany, our *ferrugaria* passes as *spadicearia*, I think some at least of you will agree with me, that it is time something was done towards bringing about a common understanding; for, however little value we may attach to the "law of priority," surely nothing but confusion can arise, if we go on applying German notices of *ferrugata* to our British species of that name, when they really belong to our red *unidentaria*.

I think I may claim to have worked up nearly all the available literature on these two species, though it is too much to hope that I have not overlooked any scattered magazine notes which might have been of importance; I am indebted to Mr. W. F. Kirby for his ready help in these researches; also to the kindness of my friend Dr. Buckell, for many valuable hints in relation to the obtaining of required works of reference in the British Museum Library. It appears that the earliest description and figure of either of these species are by British authors, and refer to the black form of *unidentaria*, Haw. Ray, in his "*Historia Insectorum*" (1710), p. 223, No. 16, gives a very fair description of it, and the words "areolâ in medio latâ, transversâ, nigrâ," leave no doubt, which of our two *Coremias* is denoted. Albin follows, in 1720, with figures of the larva, pupa, and imago of the same species (*Natural History of English Insects*, No. 97 e-h); he says that "The caterpillar was ash-colour. It was found on the white lady's-bedstraw, in the marshes near Rotherhithe, the 3rd of September;" The moth which it produced he figures with black band, and with the ochreous of the ground colour somewhat exaggerated. This figure is of interest as explaining the occasional citations of "*ferrugata*, Alb." by Guenée and other French authors, according to their absurd custom of giving the name of the first author to describe or figure an insect as sponsor to its scientific name. Specific, or trivial names, as Dr. Buckell reminded us in his valuable paper of March 21st, 1893, begin with Linnæus in 1758, 38 years after Albin.

Linnæus in the *Systema Naturae*, does not refer at all to these species; we owe the name *ferrugata* to his disciple Clerck, who, in his *Icones Insectorum Rariorum*, 1759, (pl. 6, fig. 14), figures one of our two species under that appellation; Linnæus following with a brief diagnosis in the *Fauna Suecica*, Ed. Alt., 1761 (p. 338, No. 1292); "alis purpurascentibus; strigis tribus albidis, postice cinereis; macula didyma fusca." The next name in the field was Hufnagel's *corculata* (*Berl. Mag.*, 1769, p. 616, No. 94); Werneburg, on account of Rottemburg's size-indication, "size of *Ph. notata*," has indeed supposed this name must be a synonym of *quadrifasciata*, Cl.; but the whole description seems to show that it really belongs to the commoner *unidentaria*, Haw., and it was so accepted by Borkhausen (who cites it to his *linariata*), and by Zeller, Herrich-Schäffer, and Staudinger. There can be no doubt that it belongs to *unidentaria*, Haw., rather than *ferrugaria*, Haw., for though Hufnagel describes it as "reddish-brown," and Gleditsch (*Forstwissenschaft*, ii., p. 50, 1775), as "red and light brown," yet Rottenburg, who is the fullest and most reliable, distinctly says that the transverse

band is "broad, and almost entirely black," and none of the three mention any conspicuous ochreous colour in the outer area; while the popular German name given, "the black C," referring to the C-shaped union of the "twin spots," is much more frequently applicable to *unidentaria* than to its ally, though both are very variable in this respect.

In 1776, the *Vienna Catalogue* gave us *spadicearia*, "the ochre-brownish red-striped geometer," which Fabricius, Illiger, and Treitschke, take for a variety of *ferrugaria*, W. V. Borkhausen's *spadicearia* (*Eur. Schmet.*, V. 190, 1794), is no doubt identical with this, and is certainly the extreme form of *ferrugaria*, Haw., of which I have examples from Dr. Staudinger, at the top of my second drawer.

Borkhausen's *linariata*, through a misunderstanding of Fabricius (who describes, not very fully, our "toad-flax pug"), is described as a very variable species, and is certainly either *unidentaria* or, comprehensively, both the allied species; but the name is applied too generally to be even available as a varietal appellation.

Esper figures *ferrugaria*, Haw. (*Die Schmett. in Abbild.*, pl. 40, fig. 5) under the name of *alchemillaria*, which must be due to some misunderstanding, for he quotes De Geer, whose *alchemillata* is quite another species, namely *didymata*, *L.*

Next Haworth (*Lep. Brit.* II., p. 308), not knowing Hufnagel's name *corculata*, rechristens the black species *unidentaria*; he had apparently seen red forms of that species, but took them for varieties of *ferrugaria*; for he describes *ferrugaria* var. β as "dirty reddish" with the band perfectly entire (*i.e.* not striated) and "*invenuste dolabriformi*," the very expression he uses of the band of his *unidentaria*, while his other forms of "*ferrugaria*" are distinctly to be separated from *unidentaria* by the band being "*nec invenuste dolabriformi*." The shape of band which is typical in *unidentaria never*, to my knowledge, occurs in *ferrugaria*, Haw.; though, unfortunately, that which is typical in *ferrugaria* is often nearly followed in varieties of *unidentaria*.

Lastly, Staudinger in his 1861 catalogue burdened the synonymy with yet another name *freyeraria*, due to the announcement made by Freyer in his *Neue Beiträge*, 1858, that there were two species which invariably bred distinct, and which Freyer figured as *ferrugaria* (black) and *spadicearia* (red); Dr. Staudinger had not seen Freyer's species and was also then ignorant of *unidentaria*, Haw.; consequently he accepted the black figure as *ferrugata*, but considering the name *spadiceavia*, Bkh. pre-occupied by the "aberration" to which I have already referred, he had to re-name the red species (*spadicearia*, Freyer = *ferrugaria*, Haw.), and selected the name *freyeraria*. Between 1861 and 1871 he made acquaintance with the *unidentaria* of our British authors, recognised that the equivalent of Freyer's black figure (650. I.) and consequently sunk *freyeraria* under *ferrugata*, and erected *unidentaria* as a species. But as his type of *ferrugata*, together with those of most German and French authors, is what we know as "red *unidentaria*," it is not surprising to find Speyer (Stettin. *Ent. Zeit.*, 1885, p. 93) and others declaring that *unidentaria* is "only a variety of *ferrugata*" since it has been bred from eggs of the latter. What many seemed to have failed to recognise is, that the "ab. *spadicearia*" of Staudinger's *Catalogue* is really the distinct species from their *ferrugata*; though quite recently (1890) Gumppenberg (*Syst. Geom. Zonae Temp. Septen.*, Theil iii.) has anew advocated their claim to be separated.

But the most difficult question still remains. Which of the red species did Clerck figure as *ferrugata*? I have spent a great deal of time in studying his figure, and yet I am afraid to express any positive opinion on the question. The figure is very poor, with whitish ground colour, pale red central band traversed with distinct lines, and large didymated spot, coalescing in heart form. On account of the colour of the band and the distinctness of the lines, Zeller, Guenée, and the Scandinavian lepidopterists have accepted it as representing *spadicearia*, Bkh. (= *ferrugaria*, Haw.), and Prof. Aurivillius (to whose courtesy I am indebted for some Swedish specimens sent to assist in clearing up the synonymy) sent me this species as "the true *ferrugata*, Cl." On the other hand, the whitish outer area in Clerck's figure is quite irreconcilable with any representative of this species I have ever seen, but agrees well with my "var. *corculata*" from Sweden, and with the Linnæan type of "*ferrugata*;" both these latter are certainly of the species known here as *unidentaria*, and it is noteworthy that they both have the band of a lightish and somewhat faded-looking red, not very far removed from Clerck's figure.

With regard to the Linnæan type, which I carefully examined last Christmas, there is good reason to believe it to be genuine, indeed there could be no reason for its having been re-named or interfered with in any way, since neither Linnæus nor Smith recognised two distinct allied species; it was evidently a good specimen when taken, is set in the Linnæan style, and is now somewhat faded and *minus* abdomen and hind wings; it is unquestionably what we know as "red *unidentaria*," and, as I have already said, fairly near Clerck's figure, and a still existent reddish form, as attested by my *corculata* from Aurivillius. I may add that Smith or some other British entomologist has followed it by a series of six "*ferrugata*" from England, which consist of four South English *ferrugaria*, Haw. and two black *unidentaria*, Haw.

The examples for delineation in Clerck's *Icones* were from his own collection, and those of Linnæus and others of his disciples; and it is just possible that the specimen still existing in Linnæus' collection is the very type of Clerck, though if so he has in his figure greatly exaggerated the size of the twin spots; at any rate I am rather inclined to believe that the entire absence of an outer ochreous band shows that Clerck had red *unidentaria* before him, and that therefore, as Freyer, Herrich-Schäffer, and probably Staudinger (all having access to Clerck's work) admit, the name *ferrugata* rightly belongs to the darker-banded of the two species, and that the *ferrugaria* of Haworth should be called *spadicearia*, W.V. or *spadicearia*, Bkh.

But, such conflicting views obtaining about the identity of *ferrugata*, Cl., it seems that the synonymy can only be cleared up by ignoring it altogether, and either accepting the *ferrugata* of the *Fauna Suecica*, which is universally acknowledged to be the darker-banded species, as the type, or by calling that species *corculata*, Hfn., and adopting the *spadicearia* of the *Vienna Catalogue* as the name of the lighter red species (*ferrugaria*, Haw.).

I have drawn out the following synonymic table, bracketing the name *ferrugata*, Cl. as doubtful.

1. (*Ferrugata*, ? Cl., *Ic.* 6. 14; Linn., *F. S.*, 1292).

   Corculata, Hfn., 94; Rott., *Naturf.* xi., p. 87; Aurivill. (*in litt.*).

Ferrugata ab. *corculata*, Lampa, *Ent. Tid.* vi., p. 110.

Ferrugata p., Fb., *Mant. Ins.* ii., p. 208; Hb. 285; Gn. ii., 413; Stgr. 2632; Packard, viii., 62; (*aria*) (W. V., *Fam. M.*, No. 11); ? Bkh., v., p. 387; Ill., *N. Ausg.*, p. 113; Lasp., *Ill. Mag.* ii., p. 171; Tr. vi., 2. 148; Dup. viii., 183. 6 (ad ab. *unidentaria*); Bdv. 1628; H.-S. iii., p. 149; Frr. 650. 1 (ad ab. *unidentaria*.

Linariata, Bkh., v., p. 381 (*nec.* Fb.).

? *Spadicearia* p., de la H., 240.

1a. *Ab. unidentaria*, Haw., *Lep. Brit.*, ii., p. 308; Stph., *Ill.* iii., 215; Wd., 551; Gn. ii., 414; Stgr. 2633.

Ferrugaria var., Dup.; Frr.; &c., &c.

2. *Spadicearia* (W.V., *Fam. M.*, No. 12) Bkh., v., p. 389; H.-S., iii., p. 149; Frr., 650. 2.

Ferrugata (*aria*) var. *spadicearia*, Fb.; Ill.; Led., *Spanner*.

Ferrugata (*aria*) p., Hb., 460; Tr. vi., 2. 148; Dup.

Ferrugaria, Haw., *Lep. Br.*, p. 308; (*ata*) Wd., 553; Lampa, *Ent. Tid.* vi., p. 110 (? Cl. 6. 14; ? Bkh. v., p. 387).

Ferrugata var. *Linariata*, Gn. ii., 413.

Alchemillaria, Esp., 40. 5 (& 6 ?).

Freyeraria, Stgr., 1861 *Cat.*, No. 524.

As this paper deals exclusively with the two species, isolated from their surroundings, any systematic remarks on their natural affinities, &c. do not necessarily come within its scope and must be omitted for want of time; but in order to complete our studies of their nomenclature, it may be well to say that there can be no doubt their generic name should be *Ochyria*, Hb.—already resuscitated by Packard in his *Monograph of the Geometrid Moths of the United States*. Whatever may be thought of the value of many of Hübner's genera, his *Ochyria* is almost identical in its contents with the portion of *Coremia*, Dup. now retained to this latter name and, of course, has priority by several years. In Staudinger's *Catalogue* it forms part of the great genus *Cidaria*, Tr., according to Lederer's classification.

Differentiation.—Regarding the differentiation of the two species by their wing-markings, long-continued study has convinced me that there is no single differental character which is absolutely constant, though undoubtedly the eye can be trained to discriminate them; as Mr. Eustace R. Bankes well says in an interesting letter he wrote me on the subject, "there must be to the trained eye some *combination* of peculiarities in colour and markings shown by the one species which is never present in the other, although it may be that no one special character by itself is absolutely reliable."

Mr. C. Fenn, with a considerable portion of my series of purple forms of *unidentaria* before him, as well as his own material, drew me up an admirable comparative table of the two, which I cannot do better than give *in extenso*.

" Unidentaria.	Ferrugaria.
Black.	Red.

(*None* of the *characters of distinction* seem absolute.)

FORE-WING.

A.—Median band black.	A.—Median band red.
B.—Median band followed by a generally interrupted band or a band becoming obsolete below the middle.	B.—Median band followed by an uninterrupted band continued in full intensity to the inner margin.
BB.—The second band of an ochreous colour edged with grey and divided by a similar grey line; the space between the first and second lines often paler, and sometimes with a few scattered white scales.	BB.—The second band similar to *unidentaria*, but the space between the first and second lines often white or whitish.
C.—The two submarginal spots very conspicuous, black, distinctly margined on their outer edges with whitish or the pale subterminal line.	C.—The two submarginal spots black or blackish but not very conspicuous, faintly margined on their outer edges by the paler subterminal line.
D.—A series of about four black dashes follows the submarginal spots on the extreme edge of the wing.	D.—A row of black dots follows the submarginal spots on the extreme edge of the wing.
E.—A distinct vandyke almost invariably occurs in the front edge of the median band on the subcostal nervure.	E.—An indistinct vandyke sometimes occurs in the front edge of the median band on the subcostal nervure.

HIND-WING.

F.—The band following the median (B) is rarely continued, and never conspicuously so at its hinder edge.	F.—The band following the median (B) is almost invariably continued distinctly, more especially at its hinder edge.
G.—The lower part of the wing paler than the upper.	G.—The upper part of the wing paler than the lower.
H.—No dark grey shade below the middle of the wing.	H.—A dark grey shade beiow the paleband.
I.—Four grey threads start from the inner margin but gradually become obsolete; the edge of the wing where they arise is clouded with dark grey and contains four black spots.	I.—Four grey threads above the pale band continued across the wing in equal intensity, commencing on the inner margin as black spots.

UNDER SIDE

K.—An apical dark cloud is sometimes present on fore-wing, but no cloud or shade on hind-wing.	K.—A dark apical cloud is always present on fore-wing, and a distinct grey cloud is conspicuous at the outer margin of hind-wing.

GENERAL OBSERVATIONS.

Except that *unidentaria* is slightly the larger insect, I see no structural differences except in the genitalia as already recorded. All the markings are prone to considerable variation, especially the size and shape of the median band, which is often bisected by a broad paler shade. The best character for distinction appears to be the dark shade on the hind wing, as it seems pretty constant both on the upper and under sides (H. and K.)."

I have very little to add to this; I would remark that the median band of *ferrugaria*, Haw., is never black, though sometimes very dull brownish or greyish-red; that a stronger point might perhaps be made of the paler outer area of the fore wings in *unidentaria*; that the fringes of *ferrugaria* are much more distinctly spotted than those of *unidentaria*; that the contour of the outer margin of the central fascia, and of the corresponding line on the hind wings, though very prone to vary, is nearly always distinguishable in the two species; *ferrugaria* seeming never to be so deeply bent inwards below the middle, or the band so attenuated on the inner margin, as is general in *unidentaria*; and that the dark mark on the underside of *unidentaria*, near the base of the costa, generally so conspicuous, is either weak or wanting in *ferrugaria*.

Superficially also, the whole tone of the colouring of the two species is generally different; it is very difficult, though not impossible, to pick out a specimen of each really agreeing in the colour of the band; and the Continental authors are probably right in considering that in *unidentaria* the band is never so distinctly traversed with dark lines as in *ferrugaria*; though, unfortunately, some of our British forms of the latter are almost as absolutely devoid of lines as it would be possible to imagine; but it is tolerably certain that no form of *unidentaria* corresponds at all to the extreme striated forms of *ferrugaria*, indicated by Staudinger as *ab. spadicearia* ("fascia media in strigis dissoluta") or by Haworth as *salicaria* ("obsolete strigatæ, nec fasciatæ").

VARIATION.—Both species are extremely variable, and it would not be difficult to occupy a whole paper with studies of their variation. A few general observations under this head seem worthy of being first brought into prominence:—

1.—As is usual in closely-allied species, the variation is largely on parallel lines.

2.—The variation of *ferrugaria*, Haw., is largely geographical; that of *unidentaria*, much less so.

3.—On the other hand, the influence of heredity, exceedingly strong in both species, is shown even more strongly in *unidentaria*; so that while the red and black forms exist together in most localities, yet the black forms hardly ever throw red in their progeny. The exceptions are so rare that those which have come under my notice can be recounted in a very few words. Mr. W. H. B. Fletcher's experience

of 1886 was recorded in the *Trans. Chichester and West Sussex Nat. Hist. Soc.*, n.s., No. 5, and quoted by me in *Ent. Rec.* iii., p. 151. Dr. Buckell in 1892 bred one red specimen from a dark banded ♀, which *may*, however, have been intermediate rather than quite typical black; and Mr. Harwood of Colchester also, in 1892, bred three specimens, which he describes as "reddish but so much darker than *ferrugata* that they look more like intermediate forms" amongst a lot of black specimens, from three or four black ♀s captured near Colchester in 1891; but even here one of the ♀s may not have been really *typical* black, as the dark red specimens often appear blackish when worn. If, however, the ♀ parents in these cases were really black, I can only suppose that the ♂ was of the red form.

In connection with the influence of heredity, I may say that it seems exceedingly strong in both species, so that many broods which have passed through my hands have such a strong family likeness that, if mixed among other specimens, it would not be difficult to sort them out again. The differences are sometimes so striking that Mr. R. South, having two bred broods of *ferrugaria*, Haw. before him, at one time almost inclined to think we had two species mixed under the one name; he kindly allowed me to inspect the series in question, and I saw that there would be good ground for the idea were it not that an occasional variable brood combines the different characters. A glance into my drawers exhibited this evening will show some good examples of heredity, the broods being kept carefully separate.

On this ground the species will offer a very good field for experiments in pedigree breeding, which I hope to take in hand, and for which I shall be thankful for assistance in material, especially ova from red forms of *unidentaria*, Haw. I have already commenced from a broad-banded black ♀ (labelled "G" in my drawer), and some of its characteristics are very well produced in the last specimen following it, which is a recently emerged specimen of the second generation, obtained from a pairing of two of the offspring of the said ♀; another still on the setting-board is similar.

I will next deal, as well as time permits, with the variation of each species separately.

As I have already shown under the head of synonymy, I regard the red forms as furnishing the type of what we call *unidentaria*. Avoiding the doubtful name *ferrugata*, we may call this type *corculata* Hfn., when *unidentaria* Haw., from its general constancy, is well worthy to be dealt with as ab. *unidentaria*, in which light, rather than as a distinct species, Dr. Staudinger is now inclined to regard it. Packard, the American entomologist, speaks of it as "a good example of melanism, as it occurs only in Northern Europe and the Northern American States, &c. Whether it is "melanism" or not, his knowledge of its geographical range is defective.

Hufnagel's description of *corculata*, is as follows:—"Reddish-brown, on the outer margin a black C, at the base yellowish-grey." This of course is so vague as to be practically useless, but "reddish-brown" agrees well enough with some of the "purple" forms, to allow of our uniting this name with *ferrugata*, Linn., and leaving the well-known name of *unidentaria*, to the black forms. The American red specimens (*ferrugata*, Packard), certainly belong to this species, and seem to have the central fascia generally narrower than is common in European

forms; my warmest thanks are due to Mr. H. F. Wickham, of Iowa City, for my examples, which he took great trouble to procure, at very short notice.

Corculata, Hfn. (= *ferrugata*, Cl. ?, Linn.), varies greatly in the form and breadth of the band, the brightness and general tone of its colouring, and in other respects, but I know of no special local race, nor named variety, unless the var. *asiatica*, Stgr. (*S. E. Z.*, xliii., p. 70, *Horae, Soc. Ent. Ross.*, xvii., p. 209), belongs here, rather than to the ab. *unidentaria*; as it seems to be confined to Siberia, I will not trouble you with a description of it.

Ab. *unidentaria*, Haw., in its typical form, has the band much broader anteriorly than posteriorly, and its variation runs chiefly in the direction of the narrowing of the band, though there is also much difference in the intensity of the colour of the band, while the ground colour varies from quite whitish to strongly ochreous. Haworth's diagnosis is "alis rufo-ochraceis, fascia parva basi, aliaque medio lata invenustè dolabriformi punctoque postico didymo nigris." He considers the type to have the ground colour somewhat strongly ochreous, the band externally almost bi-lobed, and attenuated at the inner margin. This includes many of our ordinary specimens, and forms, with his vars. β and γ (β less ochreous, fascia hardly bi-lobed, hind wings much suffused; γ, fascia uni-lobed, hind wings fuscous, with border very broadly cinereous), so gradual a transition that the varieties hardly deserve separating. Mr. Porritt informs me that some of the finest black forms he has seen, were from Penmaenmaur, North Wales.

There is a somewhat rare variety of ab. *unidentaria*, unknown to Haworth, which deserves notice, namely the var. *coarctata*, Warren. This has the central fascia very much attenuated throughout, sometimes reduced to hardly more than a thread; there are two in the British Museum collection, Captain Robertson has one, Mr. Fenn another, Mr. Machin a very beautiful example, and two others have recently been exhibited at our London Societies. Two slight variations of fairly common occurrence are also worthy of passing mention. Some specimens, especially when freshly bred, have a strongly reddish costa on the median area, showing, perhaps, some connection with the red-banded form, which I consider the original type of the species, though I have bred them in ordinary black broods where, as I have said, I never obtain the red forms. The other phase of variation to which I have alluded is that in which the centre of the black band is strikingly pale in its costal half, and is well exemplified in many specimens of the brood marked "I" in my drawer.

Borkhausen's *spadicearia* was described from a single specimen, and that, apparently, a somewhat rare form of *spadicearia*, W. V.; he probably also knew some of the ordinary forms, but if so, he must have classed them under his *ferrugaria* or *linariaria*. No doubt Schiffermüller used the name *spadicearia* more comprehensively, as he seems to have known the limits of his other species (*ferrugaria*, = *unidentaria*, Hw.) by breeding, but unfortunately, it is the custom now to ignore his work, on account of the lack of full descriptions. We must, therefore, take the type of *spadicearia* (= *ferrugaria*, Haw.), to be (as Borkhausen describes it) a form with a mingled ochre and pale brown ground colour, a broad brownish-red band lighter in the middle, mixed with whitish and traversed with brown lines, the discoidal spot distinct.

Guenée is probably more faithful to Borkhausen's meaning than any other author, in limiting it to this one particular form; but as it appears to be the earliest name not otherwise preoccupied for *ferrugaria*, Haw., it must now stand for the type of the species, and the commoner forms will be the varieties.

I am not sure that I possess examples quite agreeing with Borkhausen's, though it is fairly well represented by some of our Scotch forms. Forms with the band more entire, and frequently of brighter colour, such as we get so commonly in the South of England, agree rather with *ferrugaria*, Haw.; his diagnosis is: "alis cinereis fascia parva basi, aliaque lata repanda medio rufescentibus; punctoque postico didymo fusco." It will be noticed that he does not mention any conspicuous ochreous shade in the ground colour, and this agrees fairly well with some of our southern forms, but it has resulted in leading Continental entomologists, *e.g.*, Guenée and Staudinger, to connect his *ferrugaria* with theirs. This is certainly an error; Haworth's type, which I have seen, is an ordinary English form of the species we are now considering, the *spadicearia* of Germany.

Haworth's var. β, as has already been said, should be referred to the type of *corculata*, Hfn., and not to his *ferrugaria* at all. Var. γ, "fascia medio anticarum solida rufa sub-undulata. Præcedentibus varietatibus paulo minor," may probably be intended to represent some of our ordinary Yorkshire forms, as that county is quoted as locality. Var. δ seems to agree with the type of *spadicearia*, Bkh., whlle var. ϵ, and his supposed distinct species *salicaria*, are still more extreme forms.

Esper's figures of his *alchemillaria* are so bad that they cannot be taken as types of any particular form; indeed, though the ♂ is pretty obviously a fairly ordinary form of *spadicearia*, Bkh., yet I am rather inclined to suspect that the ♀ is an over-coloured example of our "red *unidentaria*."

Guenée's var. *linariata* is the common continental form with a distinct ochreous band behind the central fascia; he considered that it did not occur in England, but I agree with Mr. Fenn that it is well represented by some of our Irish forms.

Confixaria, H.-S. (334), appears to be, as Bohatsch reports (*Wien. Ent. Zeit.*, iv., p. 177), an aberration of this species "in which the many wavy lines have vanished, so that of the pattern of the fore wings the red-brown central area alone remains; the outer dentated line, with the two blackish spots in the upper third, is also indicated, etc." The band is also reduced in width, and the variation is in some degree parallel to *unidentaria* var. *coarctata*.

Many interesting casual varieties of this species have come under my notice, on which I would fain have commented had time permitted; but I must content myself with summing up its general topomorphic variation in the British Isles. The dark-banded, non-striated forms, and those with but little ochreous in the ground colour and on the border of the hind wings, (in brief, those which bear so great superficial resemblance to "red *unidentaria*"), seem to be confined to the South of England, so that I quite agree with Mr. Porritt, who, writing chiefly of the Yorkshire forms, says, "I have always been surprised that anyone knowing the two species well should have had any doubt about their distinctness." He very kindly captured some of this moorland form for me last season, and these are in my drawer this evening; but as

they were not in very fresh condition, he further sent his own bred series for my inspection. These were not striated—as I had fancied from the captured examples would be the case—but still they differed markedly from our *ordinary* southern forms:—

1.—The uniform *brightness* of the ochreous colouring.

2.—A *general tendency* to increase its quantity, *e.g.* in the marginal area and on the under surface.

3.—A somewhat frequent, though by no means invariable, decrease in the size, or partial obliteration, of the twin spots; and their general distinct separation—none thoroughly confluent, some widely separated.

4.—The well-marked hind wings, with more or less ochreous-tinted outer band. (Compare nearly all Northern, Irish and Continental specimens generally.)

5.—A general though almost indescribable difference in the *tone* of the colouring; the central band never very dark nor distinctly *purplish*, but rather inclining to ferruginous.

Scotch forms, which, according to Mr. Reid of Pitcaple, are "most abundant on the moors on dry heathery knolls and near stone fences," are similar in their general characters to the Yorkshire forms, though with an increased tendency towards the genuine "*spadicearia*" type—band paler than in southern examples, sometimes almost concolorous with the ground colour, and often more or less "in strigis dissoluta;" also, as Mr. Reid writes me:—"Our *ferrugaria* appears to me a more ochreous insect than your southern form, the band is also a little narrower and, if I may use the term, the whole insect has a looser appearance. I mean the scales are not so firmly attached as in the southern form, hence it has not such a sleek appearance," &c. I have specimens from two or three Scotch localities, and Mr. Fletcher has also kindly allowed me to examine his fine series from Rannoch and in-bred specimens from Sutherlandshire. The latter, as will be seen from a few in my drawer, which he has presented to me, are much nearer to our southern forms than the former, but still present the "loose appearance," the ochreous outer area, and the hind-wing characters which I regard as general in Scotch forms. The Rannoch form is known among some collectors as var. *salicaria*, Haw., and probably his type of that supposed "species" may have been an *extreme* striated form hereof; I have failed in my endeavours to trace either Haworth's type specimen or the one from Bentley's collection figured by Wood (555), which seems to be a very obscure, nearly unicolorous form.

The Irish forms of this species are very interesting; I am indebted to Mr. M. Fitz-Gibbon for the few which I possess; also to Mr. W. F. de V. Kane for interesting information on the distribution, &c., and for opportunity of inspecting some of his series. These strongly striated forms, sometimes with remarkably bright ochreous outer area, are, he tells me, abundant in certain localities in Co. Tyrone, Sligo, West-meath and Monaghan. They may be considered as showing a still further divergence from the *unidentaria*-like forms, in the respects indicated in dealing with the Yorkshire forms, but the variegated appearance due to striation, &c., seems to have become more fixed in parts of Ireland, as forming a local race, whereas in England it is frequently but aberrational.

With regard to variation outside the British Isles, I must not venture

to speak, the material at my command being far too limited; I have never seen a continental *spadicearia* (= *ferrugaria*) at all like *corculata* (= *unidentaria*), but I suppose such must sometimes occur, since such good entomologists as Treitschke, Zeller, and Guenée, have united the two, on the ground that every intermediate variation may be found. Zeller, however, hesitated somewhat to the last, as to whether they were not distinct (see some notes in *S.E.Z.*, xxxviii., p. 464, 1877), and the material from his collection, where the former was separately labelled "var. *spadicearia*," shows that he correctly differentiated them. Dr. Rössler of Wiesbaden, repeatedly bred *spadicearia* from the egg, always obtaining only *spadicearia*; but with singular perversity he still treats it as a mere variety of his *ferrugata* (= *unidentaria*, Haw.,) remarking that "For the production of the latter form, with dark red or black central area, other food, or greater variation of temperature, appears to be required" (*Die Schuppenflügler*, &c., 1880).

Geographical distribution.—I have been somewhat surprised to find that the range of our common *ferrugaria*, Haw., appears to be much more restricted than that of its ally. I have no certain information of its occurrence beyond the confines of Europe, though it is very probable that it may extend into Siberia. It is abundant in the British Islands, though Mr. Collins of Warrington tells me he has not taken it, but only *unidentaria*, in his district; it is also common in Scandinavia; fairly so in Germany and Austria, though generally less so, or more local, than *unidentaria*; probably common throughout France; though as no French entomologist has given us two species, records must be received with caution; Eversmann, in his *Fauna Volgo-Uralensis*, describes varieties which must belong to this species; and Doubleday's general collection contains a pretty narrow banded form, labelled "Russia." Staudinger's "Europe (except Andalusia, Sardinia and Greece); Bithynia; Altai; Amur," is entirely unreliable, as he treats all the red forms as one species.

Unidentaria, as we call it, has, on the other hand, a very wide range throughout the Palæarctic and Nearctic regions, though Staudinger, with his defective knowledge of the species, only gives England, North Germany, and doubtfully Finland, Livonia, &c. Even limiting the name to the black aberration, I have seen specimens also from Southern Germany, Vienna, Scandinavia, Zurich, and Tuscany; Duponchel figures it, and Berce (*Faune Ent. Française*, V.), indicates it as French; Snellen (*Vlinders*), as Dutch; Eversmann, as Russian, etc. Indeed, the range of this aberration is probably co-extensive with that of the red form. We may, perhaps, safely give this species the same list of localities that Staudinger has given to his *ferrugata*, with the addition of great part of North America, where, as in Europe, it is dimorphic in respect of colouring, so that American entomologists have supposed that they obtain both the *ferrugaria* and *unidentaria* of Haworth. There is some ground for believing the range of the species is also extended southward to Java, for a very able entomologist, P. C. T. Snellen, exhibited specimens collected there by Herr Piepers, in 1881, at a meeting of the Nederlandsche Entomologische Vereeniging, with Dutch examples for comparison; and the report reads that "*Cidaria ferrugata* agrees entirely with European examples of the black-banded variety *unidentaria*, Haw." On the other hand, the general representative of this species in Australasia is *cymaria*, Gn., of which I have a specimen in my box.

and which comes so near some forms of *unidentaria*, that it is just possible it may prove to be not specifically distinct, or at any rate may have been the insect obtained by Piepers, and exhibited as *ferrugata*.

In the British Isles, this species is less abundant, and more local than *ferrugaria*, Haw., and judging from the comparatively infrequent records of its red forms, and the constancy with which the black variety produces its like, it seems that our climatic conditions are more than ordinarily favourable to the production of the black race; for it appears that on the Continent, and in America, the red-banded forms are nearly or quite as frequent as the black. Even in our Islands, however, the former are by no means so infrequent as I supposed when I commenced these investigations, but are a good deal overlooked. I have seen examples from the North London district, Deal, Worthing, Isle of Wight, Weymouth, Exeter, Swansea, Rugby, Wicken, York, and from Co. Tyrone, in Ireland. Mr. E. A. Atmore also tells me that it is of general occurrence in Norfolk, and Mr. J. Collins that it is occasional in the Warrington district, while Mr. Harwood, as mentioned above, bred a few at Colchester.

Concerning the range of the black form, it will be simplest to enumerate the districts where it does *not* occur or is not common. Mr. Bankes reports that he has met with but very few in his district (Isle of Purbeck, &c.); Mr. Harwood that it "does not seem generally common here" (Colchester); Mr. Porritt that it "does not occur in the Huddersfield district at all so far as I know"; Mr. Reid that he has never seen the insect alive and thinks, "if it occurs in the North of Scotland, it must be either very local or very rare;"* and Mr. de V. Kane that his opinion is "that *unidentaria* is much more restricted in Ireland than *ferrugaria*."

Habits.—Both species are generally double-brooded, appearing in May, and again in July and August.† I learn from two or three correspondents that they (or at least *ferrugaria*, Haw.) are probably normally single-brooded in the North. Mr. Harwood thinks that *unidentaria* belongs rather to June than to May, but my experience does not bear this out. In breeding, one often gets a partial third brood, or autumnal emergence, and last season, (1893), I observed a specimen of such in September, at Hale End. There is also a tendency, no doubt favourable to cross-fertilization, for some of a brood to lie over in pupa and join the next brood, or to emerge somewhat erratically at intermediate periods of the year. Both nearly always hybernate in the pupal state, but Mr. South had a curious experience with a brood of *unidentaria* in 1890–91, when four laggards of a brood from August ova hybernated as larvæ, pupating at the end of March, and producing imagines a month later (*Ent.*, xxiv., pp. 172–3).

In many localities the two species occur freely together, but both Mr. Fletcher and Mr. Bankes have independently observed that *unidentaria* seems to have a preference for somewhat moist localities, and though both are so common at Sandown that the point had never struck

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*Dr. F. B. White (*Scot. Nat.*, iv., 173), records it as "not common" in Scotland, and only from three of his thirteen districts, "Solway, Clyde, Tay."

† The spring brood often the finer and larger, and, according to some writers, much commoner than the summer brood, though Dr. Riding's experience is just the reverse in this respect.

me, yet when my attention was directed to it, I at once recollected that my chief locality for *unidentaria* is a marshy one, while on the Downs I get *ferrugaria* almost exclusively. Mr. Harrison of Barnsley informs me that, while both occur together in the Doncaster district on wooded and low-lying limestone ground, on the "cold northern moorland about ten miles away, with scarcely anything but fir trees," *ferrugata* occurs alone and plentifully. Similarly, Mr. Porritt takes *ferrugata* chiefly on "the moorlands on the high hill sides," especially in fir woods. German authors state that "*ferrugata* (= *unidentaria*) is common everywhere in gardens, woods, etc.," while *spadicearia* (= *ferrugaria*, Haw.) occurs "only in woods," or only in hilly districts. It seems to reach an elevation of 6,000 to 6,600 feet, in different localities.

Dr. Riding remarks that *ferrugata* (as we know it here) is more frequently disturbed by the beating-stick than *unidentaria*, but that *unidentaria* comes the more frequently to light; also that the latter continues later into the autumn.

Zeller has recorded a frequent, though not constant, difference in the resting posture of the two: *spadicearia* most frequently resting on the ground with wings erected like a butterfly, *ferrugata* (our *unidentaria*) generally with them spread out flat.

Early Stages.—Mr. Fenn, whose experience in describing larvæ, &c. is too well known to require comment, has most kindly given me permission to utilize his careful descriptions, made in 1875, which I present exactly as he gave them to me:—

Ferrugaria (*English Form*).—Description made 16th June, 1875, Eltham, Kent:—

Larva.—Elongate, slightly attenuated anteriorly: head rounded, face shining. Yellowish brown, dull ochreous brown or greenish grey, mottled and shaded with dark grey on the middle segments. A series of large pale dorsal diamonds, each containing a conspicuous black spot from 5th to 10th segments; on the remaining segments a dark grey dorsal line. The anterior sides of each of these diamonds most strongly defined. Subdorsal line waved, distinct, paler than the ground colour, and a waved thread between it and the spiracles. Belly and sides below the spiracles prominently pale reddish ochreous. Spiracular line dark brown, sometimes absent. Usual spots whitish, spiracles black. A paler ventral band, margined on each side with a grey band, between which and the spiracles is a row of black spots or dots. Head dull whitish, the outside of each lobe black, and two grey bars down the face.

Pupa.—Highly polished, moderately stout. Anal extremity with a short strong spike. Bright red brown, wing cases and dorsal shade darker brown.

Unidentaria (*English Form*).—Description 25th September, 1875, Eltham, Kent:—

Larva.—Elongate, slightly attenuated anteriorly; head rounded, face shining. Dark blackish brown on the back and sides; the last four segments paler, often whitish. An orange or reddish ochreous dorsal triangle outlined with black, and often filled up with dark brown on each segment from the 5th to the 9th (or 10th), the apex in front, and enclosing a conspicuous black spot. On the other segments a blackish ill-defined and interrupted dorsal band. Subdorsal line pale ochreous, broad from the 10th to the 13th segments., threadlike on the remainder.

Spiracles black; below them the sides are very prominently reddish ochreous and paler. Between the subdorsal line and the spiracles is a pale waved thread. Belly brownish, with a broad, pale, ochreous central band enclosing a brown thread and edged with two brown threads, between which and the spiracles a row of black dots is usually situated, or a broad, blackish, much-interrupted band. Head pale brown, dusted with darker, and with a broad, black dash on the outside of each lobe. A conspicuous black dash in front of the first pair of prolegs.

Pupa.—Highly polished, moderately stout. Anal extremity with a short strong spike. Dark red brown, wing cases and dorsal shade ill-defined, often not indicated by colour.

Ferrugaria var. *salicaria* (Scotch form from Rannoch), described 19th July, 1875. This form is, I believe, single-brooded.

Larva.—Elongate (stouter than the English form), slightly attenuated anteriorly: head rounded, face shining, spots raised. Ochreous with a pink tinge, mottled and shaded with grey on the anterior segments A series of large pale dorsal diamonds, each containing a conspicuous black spot, from 5th to 10th segments; on the remaining segments is often a dark grey dorsal line. The anterior half of each of these diamonds is outlined with black and filled up with pinkish, thus forming a triangle with blunt apex, having a black spot below the base. Sub-dorsal and a line below it waved, thread-like, of a paler shade than the ground colour. Spiracular line dark grey, spiracles black. Belly and sides below the spiracles pale pinkish-ochreous, sometimes ochreous or reddish. A pale ventral band, edged with a brown shade, containing two black lines, and with a row of prominent marginal black spots, one on each segment, from the 4th to the 10th.

Pupa.—Highly polished, moderately stout. Anal extremity with a short strong spike. Bright red brown, wing cases and dorsal shade darker brown.

"From these descriptions you will observe that there is really more difference between the form *salicaria* and *ferrugaria* than between the latter and *unidentaria*. In the one, mention is made of dorsal diamonds and in the other, of triangles, but the variety supplies the connecting link and explains the reason . . . . . The three larvæ are practically identical, the exaggeration or obliteration of the markings of the one would make the description of the other apply. Here again we have the colour difficulty; they are (I allude to our English species) so excessively variable that mere colour is no guide. Of the Scotch form I had only some eighteen or twenty larvæ and they did not vary much, but this is too small a number on which to base an opinion.

"The pupæ again seem the same, allowing for the colour question" (C. Fenn, *in litt.*, 4th March, 1893).

I quoted Mr. Sydney Webb's notes on the larvæ in the *Record* (iii., p. 151). I may add that many years ago Mr. D'Orville, of Exeter, bred both species side by side three years consecutively, without being able to distinguish the larvæ (*E. M. M.*, i., p. 92). I have a few empty pupa cases here this evening, and you will observe that these differ quite perceptibly in colour, and this difference is not correlated with that of the band of the imago.

Several exact dates have been put on record in our English magazines on the duration of the early stages in different broods; for

these I may refer you to *Ent.*, xxiv., 172, and *Ent. Rec.*, iii., 176, 255; iv., 224, 292. These, however, vary so much in different broods and at different periods of the year, that I do not attach much value to them.

The larvæ of both species are very general feeders; Albin found the larva of *unidentaria* on *Galium*, and both species affect that in a state of nature, but are not confined to it. I knocked two larvæ of *unidentaria* out of a bank at Hale End, on which there was no *Galium*, but cannot say positively from what plant they came. The authors of the Vienna Catalogue cite chickweed (*Alsine media*) as food-plant for their *ferrugata*, and this has been very largely followed on the Continent; though Schreiner (*Bericht des Lepidop. Tauschvereines*, 1852, p. 55) doubts the general correctness of this, as he diligently searched in many places where the moth was abundant, but was unable to detect the plant. O. Wilde (*Die Pflangen und Raupen Deutchslands*) gives *Galium* for both species, and Dr. Rössler records that Heydenreich found the larva of *ferrugata* (? both species), plentifully on *Daucus carota*. Mr. D'Orville (*E. M. M.* i.) states that the larva of *unidentaria* has a preference for *Glechoma hederacea*. As a matter of fact, both will feed on almost anything that is offered them up to hawthorn, if not further; as already communicated to some members of this Society, I generally breed mine when at home on the common garden marigold, at Sandown on bed-straw. The only failure I have heard of through unsuitable food is one recorded by Mr. Fletcher, who lost nearly all his larvæ through trying to rear them on *Cerastium*.

In conclusion, I have only to tender my best thanks collectively to the very many entomologists (too numerous to mention individually) who have freely given me all the information and assistance in their power in these, to me, most interesting investigations and studies.

April 3rd, 1894.—It was unanimously resolved to send a letter of condolence to Mrs. Weir, expressive of the great regret with which the Society had heard of the sudden death of Mr. J. Jenner Weir. Exhibits:—Mr. Tremayne; *Nemeobius lucina*, *Lobophora hexapterata*, *Thecla rubi*, *Tephrosia extersaria*, *Notodonta dodonea*, and others taken by him in the New Forest, at Whitsuntide 1893. Mr. Battley; *Nyssia hispidaria* from Epping Forest. Mr. Nicholson; a ♀ *Euchloë cardamines*, bred from ova found in the New Forest. Mr. Southey; *Cidaria suffumata* from Hendon, where it seemed to have become almost extinct. Mr. Lewcock; *Silpha subrotundata* from Ireland; he believed this to be quite distinct from *Silpha atrata*, although it was considered by many as merely a variety of that species. Mr. Tutt; pupæ of *Thais polyxena*; these pupæ appeared to form a connecting link between *Parnassius* and *Papilio*; they were attached to twigs by the tail, and also by a belt, which, however, did not pass round the waist as in *Papilio*, &c., but was held by two hooked processes on the head of the pupa; these hooks were probably evolved from the two ear-like points found in *Papilio*: he also exhibited drawings of a typical pupa of *Papilio*, to illustrate some remarks which he made on some apparently insignificant, but really important points, in the structure of pupæ. Mr. Battley had found *Taeniocampa populeti* fairly common near Broxbourne; it was found chiefly on sallows which were in close proximity to aspens, but could also be obtained by searching the aspen

twigs after dark; in the same locality he met with the following species and read:—

Notes on the habits of Brephos notha.—This species occurred on the outskirts of a wood near Broxbourne, in which were a few aspens. The moths began to fly soon after 10 a.m., at which time they were, like *B. parthenias*, very sluggish and easy to capture. About mid-day they retreated into the thicker parts of the wood, but at 2.15 p.m. they suddenly appeared in large numbers on the sheltered side; after five minutes' flight they went back again into the wood for about ten minutes, when they again re-appeared; this was repeated several times.

Mr. Tutt said that *B. notha* was to be obtained in some numbers by shaking the aspens at dusk.

April 17th, 1894.—Exhibits:—Mr. Smith; *Thecla betulae* and *Lycaena argiolus* from Epping Forest. Mr. Bacot; *Nyssia hispidaria* and *Taeniocampa munda* from Chingford; the latter, which were bred, consisted mainly of the var. *immaculata*. Dr. Chapman remarked that in years when this species was plentiful the specimens showed no great variation, but when it was scarce, those specimens which *did* occur, usually varied considerably, both from the type and *inter se*. Mr. Goldthwait; *Asphalia ridens*, bred, from the New Forest, and one dark specimen from Ongar Park Wood, Essex; also a fine specimen of *Vanessa antiopa* taken in Monk's Wood, Essex, on April 7th, by Mr. Whittingham of Walthamstow. Mr. Mera; several hybernated larvæ of *Orgyia gonostigma*, part of a brood hatched last June, the majority of the brood having fed up and emerged in the autumn. Mr. Clark; a black specimen of *Phigalia pedaria* from Barnsley, and two specimens of *Crambus pinetellus* from Scotland. Capt. Thompson; a larva of *Zeuzera pyrina* found in his garden in Myddelton Sq., E.C.; it was comfortably ensconced in a piece of stick only slightly larger in diameter than that of its own body. Mr. Tutt; (1) a typical *Lycaena corydon*, captured in July 1893; (2) a hybrid between *L. corydon* and *L. bellargus*, taken in *copulâ* with a typical ♀ *L. bellargus*, on May 20th, 1893, at which time the latter species was very abundant, *L. corydon* not being on the wing till some weeks later; the specimen retained the external features of *L. corydon*, but had assumed to a great extent the coloration of *L. bellargus*; (3) a typical ♂ *L. bellargus* captured on the same day; (4) a ♀ *L. bellargus*, in which the pigment had failed in one hind wing; (5) a pale var. of *L. corydon*, captured in July, 1886, which was probably to be referred either to var. *apennina*, Zell., usually met with in Italian mountain districts, or to var. *albicans*, H.-S., usually met with in Andalusia; Staudinger says of the former, "*pallidior*," of the latter "*albicans*," (*Cat.* p. 12). Mr. Bacot then read the following note:—

On Assembling Selenia tetralunaria.—On April 7th, 1894, I took a freshly-emerged ♀ to Epping Forest, to see if she would attract any ♂s for me. The night seemed a favourable one, being warm, with a light breeze from the E. I hung up the ♀ in a small cage about 6.30 p.m., and she commenced calling shortly after 7. The first ♂ flew up about 7.30, and others continued to come until 8.15. They generally came up singly, and at intervals of five or six minutes; but about 8, I found three on the cage together. I found I could box them without difficulty if I did not use the lantern, but the light seemed to

frighten them. On reaching home about 10, I placed one of the ♂s in the cage with the ♀ ; he was lively for a few minutes, but then quieted down till midnight, when he began to fly again ; the ♀ then commenced to call, and they paired at 12.15, remaining together till 9.30 a.m. Some of the ♂s were of a light ochreous tint; I thought this was a characteristic of the summer brood only.

Dr. T. A. Chapman, of Hereford, read a very interesting paper "On Butterfly pupæ and the lines of evolution which they suggest." for which see Appendix.

May 1*st*, 1894.—The following gentlemen were elected members: H. H. May of Balham, P. R. Richards of Peckham Rye, G. H. Shields and D. C. Bate of Dulwich. Exhibits:—Mr. Battley; a series of *Brephos notha* from near Broxbourne, with specimens of *B. parthenias* for comparison. He remarked that the cream-coloured blotches so conspicuous in *parthenias* were practically wanting in *notha*, and the orange band on the hind wings in *notha* was not so direct as in *parthenias*; the antennæ of male *notha* were most decidedly pectinated. One of the specimens of *notha* had the left fore wing of a dirty-whitish colour, and the hind wings were much suffused with black. Mr. Bacot; a series of *Selenia tetralunaria* captured by "assembling" at Epping Forest. Mr. Gurney; *Silpha quadripunctata, Coccinella 14-punctata,* and *C. 22-punctata* from the New Forest; also *Dermestes vulpinus* from the dead body of a jay in Ongar Park Wood. Mr. Lewcock; a small but perfect specimen of *Biston hirtaria* from which a parasitic (dipterous) larva had emerged and since pupated. Young *hirtaria* larvæ had also come forth from the opening made by the parasite; these had of course been hatched in their parent's body from undeposited ova. Mr. S. J. Bell; some curious ova laid on a primrose flower taken from a bought bunch. In shape they resembled butter tubs and were of a pale grey colour with a dark brown ring round the top and another round the base; there were also two brown spots between the rings. The eggs were laid in a row. Mr. Battley remarked that queen wasps were extremely plentiful at Southend, and recommended members to kill all they came across in order to lessen the probability of another plague like that of last year.

May 15*th*, 1894.—Mr. T. L. Rix, of 20, Hartham Road, Tottenham, was elected a member of the Society. Exhibits:—Mr. Battley; preserved larvæ of *Miana strigilis* showing two *distinct* forms of coloration, *viz.* grass-green and dirty cream colour, and a third form intermediate between these two. Mr. Clark; a bred series of *Aleucis pictaria* from the New Forest. Mr. May; larvæ of *Geometra papilionaria* from Hayes, Kent. Dr. Sequeira; varieties of *Ennomos quercinaria*, including a fine dark-banded form. Mr. Prout remarked that some larvæ of *Miana furuncula*, which he had once bred, were very similar to those of *M. strigilis* exhibited by Mr. Battley. Mr. Battley stated that, during a visit to the New Forest at Whitsuntide, he had taken a larva (nearly half-grown) of *Apatura iris* from the same branch of sallow from which he took one in 1892. Captain Thompson said that he had received a letter from a Birmingham correspondent, who wrote that he had captured about twenty specimens of *Neuronia popularis*, flying low over the grass in Epping Forest, and that they had revealed their whereabouts by a slight clicking noise. Mr. Prout, Mr. Nicholson and others referred to other instances of clicking noises produced by butterflies and moths.

June 5th, 1894—Exhibits: Dr. Buckell; two eggs of the common fowl, connected at the small ends by an albuminous band; they had separate yolks and the shells were quite soft. Mr. Clark; three female specimens of *Endromis versicolor*, bred from Monmouthshire ova. Mr. S. J. Bell; three pupæ of *Pseudoterpna pruinata*. One of these was of a greenish tint, the larva having spun up in a leaf; one was suffused with very dark grey, the larva having pupated in a cocoon on the surface of the earth; the third was normal, although the larva had mingled particles of earth in its cocoon. Mr. May; a blackish suffused male specimen of *Ellopia prosapiaria* from Weybridge. Mr. Bayne; a specimen of *Notodonta dictaea* from Wood Green. Mr. Mera; a bred series of *Cidaria silaceata* from Morpeth; they were similar to southern specimens. Mr. Nicholson; two specimens of *Atelabus curculionoides* from Epping Forest. Mr. Battley; *Pyrrochroa serraticornis* from Loughton. Mr. Bacot read the following:—

"Notes on the ova of Selenia tetralunaria.—On April 7th I paired a bred ♀ of this species with a perfectly sound ♂ captured in Epping Forest; they remained together from 12.15 p.m. to 9.30 a.m. and were in no way interfered with. Both were rather large specimens; the ♀ was very dark and the ♂ very light in colour. The ♀ commenced laying the next night, and continued to lay a few eggs each night for eight or ten days. The eggs, bright green in colour, were generally laid singly and attached by their side to the box. On April 13th I noticed two or three bright red eggs in the chip-box, and there were a few more observed on subsequent days. Altogether the batch consisted of 8 of these red eggs and 136 green ones. The first larvæ hatched on May 8th, and a few more appeared during the next few days, but *only the red eggs* were fertile. My impression is that these were not laid until the 12th, as I could see no change or difference of colour in any of the eggs up to that day. I examined them every morning, and am quite sure that while there were no red ones in the box on the morning of the 12th, there were two or three present on the 13th. It is strange that such a small number should have been fertilised, seeing that copulation was in no way interfered with. It would appear to have been a few of the eggs from the middle of the batch that proved fertile, and not those first laid, as might have been expected."

June 19th, 1894.—Exhibits: Dr. F. J. Buckell: a specimen of *Pararge egeria*, sent by Mr. Hodges from Guernsey, which was very nearly identical with the Linnæan type (*egeria*), which differs from the ordinary British form (really var. *egerides*, Stdgr.) in having the spots dark brownish-orange instead of straw-coloured. Mr. Battley: various species of *Taeniocampa* from Broxbourne, including a specimen of *T. stabilis* with the stigmata confluent on both fore-wings, a single line surrounding both; Mr. Bate said he had bred a similar specimen this year. Mr. Clark: several specimens of *Selenia lunaria*, forming part of a brood which had been gradually emerging since Christmas last. Capt. Thompson: cocoons of *Plusia festucae*, sent by Mr. Arkle from Chester, with an accompanying letter to the effect that he had taken them on the 13th of June spun up in leaves of sedge; the leaves were bent downwards at an obtuse angle by the contraction of the silk of which the cocoons were made; this bending did not take place with

the yellow iris on which they were *occasionally* found, but on which the larva readily feeds. Mr. Prout: a bred specimen of *Melanippe sociata* of a yellowish tinge; this specimen had lain over in pupa throughout the winter, the remainder of the brood having emerged in the previous autumn. Mr. Bate: a specimen of *Polyommatus virgaureae*, which was given to him by the son of the Rev. S. Fellowes of Pulham St. Mary Magdalene, Norfolk, at which place he believes it was taken about ten years ago. Mr. Francis Buckell of Romsey, Hampshire, who was present as a visitor, exhibited drawings, made by himself, of the microscopic appearance (under a magnifying power of about 300 diameters) of the POLLEN-GRAINS of many species of plants. He said that he was not aware of any record of observations on this subject. He had already examined and sketched the pollen-grains of nearly 700 species of plants, and found that there was considerable diversity as regards their shape, size, colour and density. The usual colour was yellow, but some were purplish-black and others of a beautiful red, whilst those of the grasses were transparent like glass. The prevalent shape was some form of oval, and the species composing each Natural Order presented broadly (with a few singular exceptions) a general similarity as regards their pollen. Thus in the *Compositae* the grains were round or oval, and furnished with a large number of projections; the *Umbelliferae* had smooth narrow spindle-shaped grains; those of *Onagraceae* were mostly very large and triangular, and often with marked projections at the angles; the pollen of the *Boragineae* was somewhat like a short dumb-bell, and one of the genera in this order, *Myosotis*, presented grains of excessive minuteness, although curiously the species with the smallest flower (*M. versicolor*) had the largest pollen of any in the genus. In the *Geraniaceae* the grains of the species with the smallest flowers were quite as large as of those with the largest. A very curious shape characterised the pollen of *Limnanthes douglasii*, each grain being somewhat like a two-legged stool. The grains of some species of the genus *Salvia* presented the most beautiful and elaborate surface-markings. Mr. Buckell suggested that the explanation of the varied forms of the pollen-grains would have to be sought, partly in the stigmatic exigencies of the flowers and partly in the structure of the organs of the different insects engaged in fertilising the ovules by carrying the pollen from one flower to another; doubtless a process of evolution with regard to the grains might be discovered by careful investigation of the various orders, genera and species. Amongst the drawings exhibited was one showing the results of an examination of the pollen from the leg of a humble-bee; there were grains from five or six different species, and it was evident that this humble-bee, at all events, had not limited its visits to a single species of flower, as is alleged to be the case with the honey-bee.

July 3rd, 1894.—Exhibits:—Mr. Clark: a large number of Australian Lepidoptera received from Mr. Anderson; also living larvae of *Selenia lunaria*. Mr. May: an empty cocoon of *Plusia moneta* from Weybridge. He stated that the moth had emerged from this a few days previously. Mr. Hollis: bred specimens of *Ocneria dispar*. Mr. Prout: bred series of *Eupithecia assimilata*, upon which he made the following remarks:—" These specimens were reared from five different females taken in 1893. Brood No. 2 was a failure, but the others

showed a decided tendency to heredity. Brood 1 was composed of small specimens, inclining to a dull unicolorous form; Brood 3, similar, but larger; Brood 4, fine large reddish specimens, well marked, especially behind the central spot; Brood 5, delicate greyish tone, recalling the tint of *E. subnotata*. This species is only partially double brooded. Brood 1, from a female taken 11th June, 1893, produced three at the end of July, 1893, the remainder emerging in May, 1894; Brood 5, from a female taken 11th August, 1893, fed up during the autumn, the imagines appearing in May. They fed either on currant or hop, but refused flowers, while the allied *E. absynthiata* feeds on ragwort flowers, and refuses hop." Dr. Sequeira: *Meliana flammea*, *Viminia venosa* and *Macrogaster arundinis*, all from Wicken Fen. Dr. Buckell: *Nisoniades tages*. He called attention to the presence in the males of a fold along the basal half of the costal margin of the fore wings. The same character is also present in *Pyrgus malvae*, and is probably a scent organ. Mr. Bacot: full-grown larvae of *Amphidasys prodromaria* feeding on cherry. Mr. Battley: flowers of *Orchis pyramidalis*, *Ophrys apifera* (Bee orchis), and *Gymnadenia conopsea* (Scented orchis) all from Reigate. Mr. Bate said that he had made further enquiries as to the specimen of *Polyommatus virgaureae* exhibited by him at the last meeting, and that no doubt seemed to exist as to the authenticity of the capture, which took place in July or August, 1880.

July 17*th*, 1894.—Exhibits:—Mr. Oldham: a specimen of *Rumia crataegata* with very distinct transverse lines; also some rats killed by poison. Mr. Battley: *Macrogaster arundinis*, *Hydrilla palustris*, *Herminia cribralis* and *Nascia cilialis*, all from Wicken, and *Spilodes sticticalis* from Tuddenham. Mr. May: bred specimens of *Plusia moneta*, *Geometra papilionaria* and *Ellopia fasciaria*. Dr. Buckell; living specimens of *Bombyx quercus* received from Mr. A. J. Johnson of Erdington, near Birmingham. He read a letter from that gentleman, in which he stated that he had placed three bred specimens (two males and a female) in a box, and shortly afterwards noticed that the two males were *in cop*. He further suggested that one of them might be hermaphroditic, although they appeared to be typical males. Capt. Thompson: pupæ of *Nonagria elymi* in stems of *Elymus arenarius*.

August 7*th*, 1894.—Exhibits:—Mr. Sauzé: a long series of *Coccinella variabilis* from Sydenham and other localities. Mr. Lewcock: a nearly full-fed larva of *Smerinthus tiliae*. The meeting was very small, many of the members being away for their holidays.

August 21*st*, 1894.—Mr. Clark, in referring to the death of Mr. William Machin, formerly a member of the Society, proposed that a vote of sympathy be sent to his relatives; this was accordingly done. Exhibits:—Mr. Gregor: *Acidalia marginepunctata*, *Agrotis strigula* (dark), *Cidaria populata*, *Larentia olivata*, *Hypsipetes sordidata* (some fine forms) and a suffused banded form of *Camptogramma bilineata*, all from North Wales. Mr. Gates: a number of microlepidoptera, mostly bred, from the Hammersmith neighbourhood, including *Fumea intermediella*; the females of this species never leave the larval case. Mr. Clark: *Meliana flammea*, *Bankia argentula*, *Acontia luctuosa* and others from Wicken.

Mr. Lewcock: *Pachyta collaris, Cryptorhynchus lapathi* and many other coleoptera; the larva of *C. lapathi* feeds in the stems of willow and sallow. Dr. Buckell: *Bupalus piniaria* (♂ s) from Oxshott and West Wickham, with a Scotch specimen for comparison; one of the Oxshott specimens had those portions of the wings which are usually yellow as white as in the Scotch specimen, whilst in another specimen the black had encroached much more than usual on the yellow, and on the hind-wings had almost entirely obliterated it; also two pupæ of *Nemeobius lucina* attached to a withered primrose leaf; the larvæ hatched on June 12th, and pupated on July 23rd; during their earlier stages the larvæ remained on the fresh leaf all day, but in their later stages they left it during the day and rested on the bottom of the glass in which they were being reared; this fact suggests that the larvæ might be looked for during the day under leaves resting on the ground or on the ground close to the plant; when the time for pupation came neither attached itself to the fresh leaf, but both retired to the withered leaf on which they now are, and which happened to be in the jar: also a specimen of *Miana strigilis* from Highgate, with a reddish band near the hind margin of the fore-wings. Dr. Buckell also read:—

"Notes on the parallelism, in their earliest stages, between Eugonia quercinaria and E. autumnaria.—I obtained a batch of eggs last year from a bred ♀ *E. quercinaria* paired with a bred ♂, both of them from larvæ taken in Kensington Gardens. In April last Capt. Thompson brought me some eggs of *E. autumnaria* to rear for him. Rearing the two species side by side, I was struck with the following points of parallelism between them. 1. The eggs were (to the naked eye) indistinguishable, their shape is peculiar (vide *Ent. Rec.*, vol. iv., p. 236); Mr. Tutt describes it (*Ent. Rec.*, v., p. 114) as 'a rather square-based parallelopiped.' 2. In both cases the eggs were laid overlapping one another (imbricated)). 3. In both alike the hatching process extended over very nearly a month. 4. For pupation both spun leaves together, *E. quercinaria* very loosely, *E. autumnaria* somewhat more firmly."

Mr. Riches announced that he had bred several specimens of *Apamea ophiogramma* from "Ribbon-grass;" a discussion ensued as to the proper food of this larva when in a wild state. Dr. Buckell said that the Rev. C. R. N. Burrows of Rainham had bred 3 ♂ and 3 ♀ *Anticlea berberata*, which he placed together in a glass-topped box with a spray of the food plant; on the first night each ♀ found a mate; on the following night some were paired again, and the same thing happened on the third night. Mr. Bacot read:—

"Further notes on Selenia tetralunaria.—From the fertile ova of the batch upon which I communicated some notes to the Society on June 5th, I bred 6 imagines, which emerged during the first week of July. I tried 'assembling' with them on two occasions, but without success; probably it was too early for the 2nd brood in a state of nature. I, however, paired two of those I bred, and, with a view of following up my former observations, removed the female to a fresh chip box each day. The pairing took place on the night of July 4th. On the night of July 5th 97 eggs were laid; these were deposited in one large loose patch and several smaller ones (the female of the spring brood laid her eggs in twos and threes only), they had not turned red on the night of the 6th, but were all red next morning (7th). On the

night of the 6th 34 were laid; they were more scattered than on the previous night, but there was one loose patch of 18; at 1 p.m. on the 8th these were darkening but not yet red; by 7 a.m. on the 9th they had turned red. On the night of the 7th, 11 were laid; at 7 a.m. on the 9th one of these had turned red, the rest were only flesh-coloured; by 9 a.m. on the 10th all were red. On the night of the 8th, 11 were laid; at 7 a.m. on the 9th all these were of a dull orange except one, which was red; on the morning of the 10th two more had become red, and on the evening of the same day all were pale red—one very dark red or purple. On the night of the 9th, 4 were laid, which were all pale orange the next morning, and all red on the 12th. On the night of the 11th two were laid; next morning one of these was pale red, the other dirty yellow; on the 15th both were dark red. These observations seem to confirm the opinion I expressed in my notes on the spring batch to the effect that the few fertile eggs of that batch were laid in the middle of the period of deposition. I did not take note of the exact tint of the freshly-laid eggs for the first two or three days, but I do not think that they differed much from the infertile ones of the former batch. Some of the later ones, however, if not orange-coloured when laid, must have changed very rapidly, as they were already of that tint when I examined them only nine or ten hours after their deposition, and it will be noticed that one egg turned red in this short space of time."

Sept. 4th, 1894.—Exhibits:—Dr. Buckell: *Epinephele tithonus* (♂ s) from Leigh, Essex, showing extra ocelli; Mr. C. G. Barrett (*Lepidoptera of the British Islands*) remarks, that this species is liable to develop extra ocelli in maritime localities. Mr. Nicholson: *Eugonia quercinaria,* bred from ova laid by a female, which was bred from a larva beaten in the New Forest in 1893; many of the specimens were strongly suffused with brown at the base and hind margins of the fore wings, although neither parent was specially conspicuous in that respect. Mr. Clark: *Dicranura bifida* from Monmouthshire ova; he stated that he found it impossible to obtain eggs from this species in captivity. Mr. Mera: a very beautiful and variable, though short, series of *Agrotis tritici* from the East Coast. Mr. Sauzé: a series of *Formica nigra,* showing males, females and neuters, also a female after the wings had been snapped off. Mr. Bacot: young larvæ of *Dipterygia scabriuscula*; also a short series of *Selenia tetralunaria,* bred from the ova on which he read a note at the meeting on June 5th. Dr. Sequeira: a specimen of *Agrotis pyrophila* among other insects taken at Ilfracombe. Mr. Huckett: *Dianthoecia albimacula* and *Sesia chrysidiformis* from Folkestone. Capt. Thompson: *Eupithecia nanata, Scodiona belgiaria* and *Pleuronota bicostella* from the West Riding of Yorshire, and *Grapholitha nigromaculana* from Rainham. Mr. Tutt then read the following interesting notes of a holiday spent with Dr. Chapman in the Alps:—

BUTTERFLY-CATCHING IN THE NEIGHBOURHOOD OF MONT BLANC.

Overhead the sky is of a lovely blue. The sun's rays pass through the larches and fall upon a sloping hollow that is filled knee-deep with scabious and thyme, marjoram and gentians, umbellifers and trefoils, barberry and juniper. Two lazy fellows are lounging idly in the shade

at a little distance from each other, each trusting that the other believes him to be working as hard as possible while he is really glorying in his own laziness as he feasts his eyes on the snowy dome of Mont Blanc, or on the necklet of cloud from out of which stands up, black and grim, the sharp point of the Aiguille Noire de Peteret. Yonder the Glacier de Brenva shows its white névé, glistening in the brilliant sunlight, whilst The Grammont and Chétif smile grimly across the Dora Valley at the two make-believes on the opposite side. Lovely is the Dora Valley, with its turbid glacial streams, its emerald green, its snow-capped mountains, and its beautiful flowers. Round this delightful spot, in favourable localities, butterflies and moths don't simply exist—they swarm.

Let us glance at some of the butterflies that may be captured round about Courmayeur on a morning in early August.

In the valley below there *Papilio podalirius* flies lazily but gracefully about, sipping from every muddy spot. The few *P. machaon* we see are worn and broken, and a half-fed larva, picked up on the bank, tells us that we have hit on a time between the two broods or else that the summer brood is past. But *the* butterfly of these slopes is *Parnassius apollo*. A lazy, high-living chap is he, sucking away greedily at the nectar of knapweed or scabious, too intent to mind the fingers that pick him tenderly from his food, simply throwing out his fore legs in a wondering sort of way as much as to say, Where am I now? As we put him back he goes on sucking again, flaps his wings once or twice to satisfy himself that he has discovered where he is and then, after a time, spreads his wings and launches himself in the air so lightly and easily that you fail to see his wings vibrate to keep him in motion. A really fine fellow it is, with its crimson spots varying in size and number, dependent, my companion says, on sex; but this flight makes one think that, in spite of the neuration being so different, the osmaterium of the larva is a better guide, and shows that it has closer affinities to the Swallow-tails than one would otherwise be inclined to suppose. *Leucophasia sinapis* threads its way slowly through bush and grass and occasionally settles as lazily as it flies, in spite of the fact that some of our English collectors think that this species has solved the problem of perpetual motion. In yonder lucerne fields *Aporia crataegi* disports itself, the almost diaphanous females reminding one of *P. apollo* and giving one the notion that the most perfect specimens are but in poor condition. With it are *Pieris brassicae* and *P. rapae*, but *P. napi* does not put in an appearance, although we met with it later on at Aix-les-Bains. *Pieris daplidice* flits easily along, but a regular "artful dodger" it is. It flies slowly, and you cannot help distinguishing it at once on the wing, notwithstanding all that has been said to the contrary. But for all its slow flight you often miss it; it dodges just as you strike, changes its mind perhaps when the shadow of the net falls on it; at any rate you miss about as many as you catch. *Gonepteryx rhamni* is just coming out, but no *G. cleopatra* are seen. The "Yellows" are in fine condition and in the humour to hunt a fellow on the hill-side. You may talk about hunting butterflies but I have quite made up my mind that these Clouded Yellows hunt me. One took me a pretty dance; I nearly broke my neck—and got a peep at him; had after him again—and got a telescopic view at about six yards; then he beamed on me as he turned suddenly and passed within an inch of my

nose, just as I was calculating whether I was to sink gracefully on my back on the bank or roll with the loose stones I had incautiously stepped on and thus end my existence ; then, when I recovered, I saw him hovering over a flower at the very spot whence I had started, but when I got there he was just sailing away over the larch trees. I didn't give them much chance of hunting me though, for we soon arranged matters satisfactorily, and whilst *C. edusa*, *C. hyale* and *C. phicomone* flew peacefully about the bank I lay in the shade and watched them. Argynnids were in thousands, *A. aglaia* and *A. niobe* in dozens ; and what grand fellows some of the latter are ! what marvellous variations they show in their silvery undersides—and in their uppersides, too, for the matter of that. *A. adippe* and an occasional *A. paphia*, together with a much larger but closely-allied species, with a really grand underside of green and red, were mingled with such lovely *A. latona*. Just out of pupa, they waved their wings airily, now on a flower, then on the rock at one's feet. *A. selene* I saw once, I believe, but *A. euphrosyne* was not. A half-dozen other species besides perhaps fell in our way here, but their names are not on British lists, except perhaps *A. dia*, which sometimes is and ought not to be. All our British Melitæas occurred and many others besides—*M. cinxia* on the hill-side, *M. aurinia* high on the mountains, probably long over in the lower regions, and *M. athalia* here and there,with *M.parthenie*, *M.aurelia* and many other species. The larvæ of *Vanessa urticae* occurred high on the mountains, where nine-tenths must starve before they come to maturity, and plenty of imagos appeared as well. *V. antiopa*, fine strong-winged fellow, was only once seen here, but others appeared in the Cogne Valley, where a pupa and evidences of some hundreds of larvæ in the shape of their cast skins were found upon the willows. *Vanessa io* and *Pyrameis atalanta* were in no great abundance, but *P. cardui* and its larvæ were everywhere. This species was found up to the highest points we reached, sailing over the top of Mont de la Saxe and the Glacier du Miage, free and unrestrained. *Limenitis camilla* occasionally haunted a shrubby honeysuckle, and *Melanargia galatea* kept company with *P. apollo* almost everywhere on suitable slopes. We made a special hunt for *Erebias*, and got some, although *Erebia aethiops* occurred but twice and both times at low levels (at Bourg St. Maurice and Grésy near Aix les Bains), but some allied species swarmed. *Erebia epiphron* in varied conditions of dotting and spotting was sometimes not uncommon. *Pararge megaera* and some allied non-British species occurred, but rarely in the higher levels, although the species was abundant in the Val d' Aosta, whilst *H. semele*, fine grand fellows some of them, were met with in many places. *Epinephele ianira*, with a double-spotted relation, and *Coenonympha pamphilus* were not uncommon. Of the Hair-streaks only one, and that a non-British species, occurred, but the lovely Coppers made up for them. Brilliant little gems are the males of *Chrysophanus virgaureae*, and abundantly they skipped from flower to flower, whilst *C. phloeas* gave us here a bright form, lower down the dark form which Mr. Merrifield has proved to accompany a high temperature and which has helped to prove that melanism is often the result of a physical (pathological) process which may be engendered in a variety of ways. But *Lycaenas* are the insects *par excellence* of the banks here. *L. corydon* and *L.bellargus*, *L. aegon* and *L. argus*, *L. astrarche* and *L. icarus*, *L. acis* and *L. minima*, *L. argiolus* and *L. argiades*, with fine dark *L. arion* sport here, and quite a dozen

non-British species besides: the thyme and marjoram teem with these strange little creatures, which make their wings appear to rotate by a process of moving those on opposite sides in different directions. No *Nemeobius lucina* were observed here, although a second brood turned up at Aix, but *malvae*-like Skippers were in dozens. How many species there were I dare not say; whether *Pyrgus malvae* was in fact one of them it is equally unsafe to assert. *Nisoniades tages* and some butterflies which resembled but were not it occurred, not here but at Aosta; but here, with the Yellows and Fritillaries, thousands of *Pamphila comma* dart about diving their probosces deep into thistle and scabious, hustling the Burnet moths, the *apollos*, and even the bees. *P. linea* and *P. lineola*, *P. sylvanus* and *P. actaeon* all occur here, *P. lineola* much the most frequently.

Thus much for some of the butterflies round Courmayeur. Those species which are not found in England find so little favour in the eyes of British collectors that this must be my excuse for not naming them; but when three-fourths of our British species and as many other non-British species besides, can be seen in one or two morning walks among some of the most beautiful scenery in the Alps, with the Sovran Dome of Mont Blanc keeping silent and watchful guard, where, when butterflies and Burnet moths pall, one can turn to lovely flowers, glacial torrents, glistening snow, sparkling cascades, silent and majestic mountains or deep deep blue sky, can watch the filmy haze weave itself into fanciful shapes around the aiguilles yonder and float off a wraith so fairy-like and light that the blue of the sky appears to pierce it, whilst the sound of the cow-bells comes peacefully from the pastures above and woos the sleepy dream-god, then I feel it safe to assert that there are many worse occupations than catching "Hampstead Heath" *antiopas*, "Dover" *latonas*, "Folkestone" *daplidices*, and Midland *dias*, on the breezy slopes of the mountains around Courmayeur.

Sept. 18*th*, 1894.—Exhibits:—Mr. Oldham: males of *Odonestis potatoria* from Wisbech; one of them was of a buff colour, except the usual oblique dark streak which was somewhat faint. Mr. Riches: *Ocneria dispar*, and some "Ribbon-grass" (*Phalaris arundinacea variegata*, also called *Digraphis arundinacea*). Mr. Gates: among other insects, *Gortyna ochracea*, and the stems of burdock from which they had emerged. Mr. Battley: 2 bred males of *Lasiocampa quercifolia* from Wicken; also *Apatura iris* (♀) and *Geometra papilionaria* from the New Forest. Mr. Bayne: *Noctua dahlii* from the New Forest and Aberdeen. Mr. Tutt remarked that this species is sexually dimorphic at Aberdeen, the males being chestnut brown and mottled, the females, dark purplish in tint, and that a similar phase of sexual dimorphism occurred in Yorkshire and in Essex. In Sligo, on the contrary, both males and females were of the dark purplish tint, and the mottled chestnut males appeared unknown, whilst at Morpeth in Northumberland the females were of the usual purplish coloration, but the males were sometimes chestnut coloured, at other times dark purple like the females. He further remarked that it was a species well worth studying, both from the points of geographical and of sexual variation. The red form exhibited by Mr. Bayne he considered very peculiar and certainly very rare. Mr. Bell: young larvæ of *Cerigo matura*, which Mr. Tutt stated fed throughout the winter on grass. Mr. Nicholson then read the following paper on:—

THE LIFE-HISTORY OF OCNERIA DISPAR.

I have chosen this insect as the subject of a paper because, having reared it repeatedly through all its stages, I have noticed several features in its history which led me to think that it would prove specially interesting, and furnish food for thought and discussion.

I will deal first of all with its nomenclature. Why the moth received its English name, "The Gipsy moth," I do not know, but the female is figured under that name in 1742 by Wilkes, *(Bowles' New Collection of English Moths and Butterflies in 12 prints, all drawn from life*, pl. x., fig 2.), who seems to have been the first British author to notice it. Scientifically it is probably best known to entomologists as *Liparis dispar*, though it is now called by the name which appears in the title of this paper. It seems to have had no specific synonyms worthy of mention, although generically it has experienced numerous vicissitudes. Linnæus called it *Phalaena (Bombyx) dispar;* Haworth, *Bombyx disparus*; then we have Hübner with *Porthetria dispar*, and Ochsenheimer with *Liparis dispar*; then Stephens and Curtis with *Hypogymna dispar*, and finally Herrich-Schaeffer with *Ocneria dispar*.

The generic name, *Ocneria*, is probably derived from the Greek *oknêiros*—"sluggish"; if this be the origin of the word, it is particularly applicable to the female Gipsy moth. The trivial name *dispar*, meaning "unlike," is most appropriately bestowed on this species because of the striking dissimilarity between the sexes.

As most of you are doubtless aware, this moth is remarkable from the fact that it has ceased to exist in a wild state in Britain and has degenerated into a purely domestic article of produce. On the Continent, however, it is anything but extinct; in fact, it occasionally becomes so excessively abundant as to strip large tracts of trees of their leaves. It is also unpleasantly in evidence on the other side of the Atlantic, in the State of Massachusetts, where Brother Jonathan employs many men whose sole business it is to keep the numbers of this insect in check, with a view to ultimate extermination. I wrote to Prof. Riley for information concerning the ravages caused by this species in the aforementioned State, and received in reply the three Reports now on the table; each of these, as you will observe, is entitled: "Special Report of the State Board of Agriculture on the work of extermination of the Gypsy Moth." The Moth seems to have been accidentally introduced into America about 35 years ago, and it gradually increased and spread to such an extent that, in 1890, £10,000 was voted by the Legislature to be expended in efforts to get rid of it. Those efforts are still going on merrily, and you will see, by the map in the Report for 1894, that about half the infested district (that is about 100 sq. miles) has been cleared of the pest. The expenditure last year amounted to about £15,000. One of the reasons given, in the Report for 1893, for its great destructiveness in America is, that it was introduced without its natural enemies; and this is the reason why those "insect pests which are of European origin have been far more injurious" in America "than they were ever known to be in their native homes." In the same Report twenty-four species of American birds (including the famous Blue Jay, immortalized by Mark Twain) are mentioned as feeding on the insect in three of its stages; there are are also four species of insects which have been found to destroy the ova, and seven true parasites which live in the larvae. I cannot give

you any information as to its parasitical enemies in Europe, but I do know that the audacious British sparrow alights on the scullery roof just outside my sitting-room window, and greedily snaps up the female moths which I discharge when I have a superfluity of them.

It has been suggested by more than one author that the species was originally introduced into this country artificially, and the following remarks by Wilkes, in the 1st edition of his *English Moths and Butterflies* (1746-60) lend some support to the suggestion. He says: –"This moth is very common in Germany, and was produced [in England presumably—*C.N.*] from a nest of eggs, that were sent to Mr. Peter Collinson, who gave them to Charles Lockyer, Esq. He bred moths from them . . . . . and having turned numbers of them wild (as I have been informed) about Ealing, near Brentford in Middlesex, they are to be found there, but not anywhere else that I have heard of." However that may be, there does not seem much doubt that it became extinct somewhere about 1855, although it is reported to have swarmed at Horning Fen in Norfolk about 1830, where it seems to have fed on sweet gale (see *Ent.*, vol. xxv., p. 259). All efforts to re-establish it appear to have been crowned with failure.

It is a remarkable coincidence that the other British lepidopteron which bore the name *dispar* is now also extinct in this country; both having been found in the same locality, and both becoming extinct within a very few years of each other.

The eggs of the Gipsy Moth are laid during the months of July, August and September in America, and I presume the time is about the same wherever the insect occurs. They are usually deposited on the trunks or branches of trees and not on the leaves, since they have to pass the winter in the egg state and would be carried away with the falling leaves, thus making it difficult for the young larvæ to obtain food in the spring. While the female is depositing her eggs she remains quiescent on one spot, no part of the insect moving except the extremity of the abdomen. The eggs are about $^1/_{16}$ in. in diameter, and are shaped like a rather flat orange. They are laid in large patches of one or more layers, each patch containing from 150 to 300 eggs thatched over with a kind of fur, which is in reality the dark, velvety scales so conspicuous at the end of the abdomen of the female. This furry substance is plucked out by means of an apparatus specially formed for the purpose, and resembling a pair of forceps in miniature. When newly laid, the egg is of a pale and somewhat watery chocolate colour; but in a week or two this changes to a dark smoky grey, and it remains of this tint throughout the winter until spring arrives, when it becomes almost black a few days before hatching.

The hatching of all the eggs in any one batch is not simultaneous, which is contrary to the usual rule in such cases, but the young larvæ continue to come forth, a few at a time, for three or four weeks, in fact throughout April. The result of this arrangement is that larvae in all stages of growth, pupæ, and even imagines are found at the same time.

When first hatched the juvenile larvæ are of a light brown colour, but they soon become a very dark greyish black, the head being quite black and *shining*. They are then about $\frac{1}{8}$ in. long, and rather hairy. The hairs are black, and spring from small black tubercles; some of them are nearly as long as the larva itself. The larva moults, or casts

its skin, four times, at intervals of from 7 to 14 days. After the first moult the colour is not appreciably altered. After the second moult the head becomes *dull* black, and the body is adorned with a dorsal series of about six orange spots. The casting of the third skin reveals a more elaborate coat, the tubercles now becoming coloured and the whole body of a paler tint; the head is also marked with yellow. The only change after the last moult is that the head is much more suffused with yellow. When full-grown, the male larva is about $1\frac{3}{4}$ in. in length; the female about $2\frac{1}{2}$ in. They are similarly marked. The head is of a rich orange colour, delicately mottled and irrorated with black and having two black stripes down the face. The body is black or grey, varying with the individual. On the back of each segment of the body are two tubercles, which emit short bristly hairs; and along each side of the larva are two rows of warts from which spring longer and softer hairs curving downwards. All the hairs are golden brown. The dorsal tubercles are dark blue on the first five segments, and blood-red on the remaining seven. Mr. Bacot drew my attention to some small tubercles situated between the large red dorsal tubercles on the 9th and 10th segments. These have been mentioned by Mr. Poulton, who, if I have heard rightly, was unable to determine their use.

Anyone who has had the somewhat doubtful pleasure of rearing a large number of these larvæ will probably have marvelled at their wonderful capacity for eating. They never seem to need the aid of the dainty little "Beecham" or "Pepper's Quinine and Iron Tonic" to improve their appetites. The only preparation of iron that would be of any service would be the woodcutter's axe, so that one could fell a few oaks and beeches, with whose leaves the perpetual cravings of the larvae could be appeased. When engaged in the, to them, pleasant business of getting outside the maximum of greenstuff in the minimum of time, the noise made by the jaws of some 200 larvæ resembles the gentle pattering of a shower of rain, as it falls on the leaves of trees and bushes. I have heard it repeatedly myself.

I have noticed a peculiar trait in the character of these larvæ, *viz*: their sensitiveness to certain sounds. When I have been talking while leaning over the aquarium-glass in which they were feeding, I have frequently seen them kick up their tails in a most irritated way, as if they were annoyed at the sound, which was probably intensified by the vibration of the glass. Similar results may be produced with other larvæ, as was mentioned in the *Ent. Rec.* for Sept. 1893, pages 240-241, where *Vanessa urticae, Bombyx quercus, Nemeophila plantaginis* and *Callimorpha dominula* are referred to as being affected in a similar way.

The larvæ of *Ocneria dispar* rest in a straight position on the stems and branches of their food-plant. If annoyed they fall from their resting-place, spasmodically jerking their heads and tails up and down. This is more particularly the case when they are young and frisky; as they become older and more staid they seem to take life more smoothly, and are not easily worried. These remarks apply equally to the larvæ of *Psilura monacha*, to which species *O. dispar* is very closely allied in every stage of its existence.

Although the larvæ are moderately hairy, I have not found that the hairs possess any "urticating" properties; but the short bristly ones on

the back are capable of giving a sharp prick when brought into contact with the tender parts of the hand.

The larva attains full growth in about eight weeks after leaving the egg; it is a rapid crawler and does not roll into a ring on the approach of real or fancied danger. It spins a very rough, open network of silk in some convenient corner, or between leaves, and therein becomes a pupa. This network in no way hides the enclosed pupa, but is only just sufficient to restrain it from rolling about or falling out.

The pupæ of both sexes are of a dark brown colour, and are besprinkled with little tufts of short hair of a lighter shade of brown. The male pupa is only about half as large as that of the female; it is rather squarer at the head and decidedly more pointed towards the tail. Both sexes rotate the tail segments very actively when touched.

The moths appear in July and August, about a month after the pupation of the larvæ.

In the early stages of this moth there is not a very striking difference between the sexes; but as soon as they arrive at the imago stage they present very few points of similarity. The male differs very materially from the female in size, colour and shape, as is evident on the most cursory glance. The antennæ of the male are beautifully plumose; those of the female pectinated. The fore-wings of the male are of a dark greyish-brown colour (either shade occasionally predominating) with darker transverse wavy lines; the hind-wings are always of a lighter tint than the fore-wings, and, as a rule, appear to be destitute of markings, with the exception of a central dark lunule: there is, however, sometimes an indication of a line parallel with the hind margin; this is rather more distinct in the female. The fringe is alternately light and dark on all the wings. The female agrees with the male in the style of the markings, but the ground colour of all the wings is creamy-white. Both sexes have a blackish dot and a V-shaped mark rather above the middle of the fore-wing. The distinctness of the transverse lines varies in both sexes, but especially in the female, and a variety of that sex occasionally occurs in which the V-shaped mark alone is present.

I am indebted to Mr. Samuel Stevens of Norwood for the loan of 2 males and 2 females of the original British race. You will notice that the second male is a very strikingly banded variety; otherwise there is no particular individuality about our old fen form.

You will see in my boxes a number of small males very much lighter than usual, and having a good deal of buff colour on the fore wings; many of them also have the thorax greyish. They are the produce of several generations, and were bred in the first instance from ova received from Mr. Bacot, who got them from Mr. Wade-Gery of Winchester College.

It was by means of a score of larvæ, which I obtained in 1886 from Mr. J. Potts of Hull, that I first made acquaintance with the species; and the acquaintance had ripened into friendship with succeeding generations, when I unfortunately lost the race in 1891.

The male Gipsy moth is extremely excitable, and flies wildly in a zigzagging manner during the day in precisely the same way as its humbler relative *Orgyia antiqua*, which, in many ways, it closely resembles. The female, on the contrary, is very lethargic, usually sitting quietly within a few inches of the pupa shell from which she has

emerged. In one of the Reports above referred to the following remark occurs: "The female does not fly, except diagonally downwards." Those which I have bred did not seem to fly at all, but they occasionally fluttered about in the box in a manner remarkably like that of the female Silkworm moth. It is probable that in a state of nature the female flies late at night.

The males, in common with those of the other species in the family *Liparidæ*, "assemble" very freely. In connection with this I tried an experiment with the present species in my sitting-room, which is about 11 feet square. One day I found that three females had emerged in my box, and I put them close together on the mantel-board, and let a small male loose in the room. The window and the door were wide open, but he made no attempt to escape, and it was very interesting to observe the steady business-like way in which he searched about, carefully investigating the corners of the floor and the ceiling, and working up and down the walls. The whole proceeding was in most striking contrast to the wild zigzagging flight above referred to. It took him about half an hour to find the females; I suppose this was because there was no breeze to assist him in localizing their position. I paid a brief visit to the Natural History Museum some time ago, for the purpose of looking up this species and its foreign allies, and was much struck with the very great similarity which many of the latter bear to *O. dispar* and *Psilura monacha*, several of them forming connecting links between the two. For instance, the male of *Enome incerta*—an Indian species—has wings almost identical with those of *O. dispar* in colour and marking, but it has a pink body like that of *P. monacha*. *E. japonica* (from Japan) is simply a larger edition of *O. dispar*, except that the female is more suffused with brown, and has only the V-shaped mark distinct. *E. umbrosa*—likewise a native of Japan—is also, in appearance, very closely related to *dispar*. The scourge of Massachusetts is figured in the Reports on the table, and seems to be very near to the ordinary forms which we now breed, which I suppose are Continental.

In conclusion, I regret that I have not any foreign types to show you, but I desire to thank those members who have brought their series here this evening to help to illustrate the paper. If I may venture to suggest some points for discussion, I think these two may be productive of some interesting opinions:—Why did *Ocneria dispar* become extinct in this country? and, Why are the wings of the female so well developed, supposing that they are *not* used for flight?

Mr. Tutt, in rising to propose a vote of thanks, said hat he would take the queries suggested by Mr. Nicholson *seriatim*. He considered that the reason why the species was extinct in this country was because it was not a native. Its whole history proved it to be an imported species even when it first became known. Thousands of specimens in all stages had been set loose in various parts of the country, but with the exception of an odd specimen here and there, no specimens were taken wild. Its abundance in the Fens for a year or two simply pointed to the care with which it was put out, and to the temporary existence of favourable conditions. There were thousands of acres of land, to all intents and purposes fitted for its establishment here, but it—possibly the agriculturists would say fortunately—will not establish itself. With regard to the second point, he doubted the statements that the females

of this species did not fly in the ordinary way. Many moths were known to pair and lay some eggs in the immediate vicinity of their emergence, before flying away to lay the remainder of their eggs at a distance from their place of birth. This was particularly noticeable among the *Arctiidæ*, and probably some similar habit prevailed here. In looking over the maps attached to the reports dealing with the spread of this insect in America, one had to bear in mind that it dealt with thousands of square miles, with an area much larger than the British Islands, and presenting great variation in physical features, and it was impossible to suppose that, however energetic the larvæ were, they could surmount rivers or mountains, or even spread over continuous large districts if their own special food plants did not exist. He felt satisfied that the supposed inability to fly on the part of the imagines was an error due to want of observation, and that at present it simply meant that they had not been observed at the right time, probably very late at night. The discussion was continued by Mr. Clark, Mr. Gates and others. Mr. Nicholson in reply said, that it certainly would seem difficult for the species to have spread without flight on the part of the female, until one was acquainted with the crawling powers of the larvæ. As would be seen from the Reports on the table, they travelled considerable distances, clearing the trees and bushes of their leaves, and even devouring low plants when arboreal vegetation failed.

Sept. 2nd, 1894.—Exhibits:—Mr. Prout: a series of seven *Leucania albipuncta,* taken on sugar at Sandown, S.W., from which he had been unable to obtain ova. He had also taken one specimen each of *Caradrina ambigua* and *Triphaena subsequa.* Mr. Battley: *Eubolia bipunctaria* and *Zygaena filipendulae* from Beer, Devon. The former were very neat, and he specially drew the attention of the members to two of the latter; one of these had the black band on the hind wings occupying nearly the whole of the wing, as is often the case in Z. *trifolii*; the other specimen had the upper spot of the middle pair of spots, reduced to a mere dot, and the spot nearest the tips, strongly bisected by the wing-ray. Mr. Bloomfield: bred *Nonagria typhae* from Bures, Suffolk. Dr. Sequeira: *Pterophorus monodactylus, Amblyptilia acanthodactyla, Oxyptilus teucrii, Platyptilia zetterstedtii, Aciptilia spilodactyla* (? Ed. from Folkestone) and *A. tetradactyla,* all from Folkestone. Mr. Bacot: larvæ of *Rusina tenebrosa* from ova from Ongar Park Wood; he remarked that they were very slow feeders, and would probably hybernate when full-grown: also a bred series of *Triphosa dubitata* from Chingford. Mr. Hanbury: a very striking, pale form of *Agrotis tritici* from Hunstanton. Mr. Clark: a variable lot of *Gnophos obscurata* from Folkestone Warren. Mr. Tutt, commenting on these, observed that this species was one which responded very readily to its environment, and hence produced very strongly marked local races. Being an insect which rested on the ground, and occurred on a variety of geological formations, it was interesting to note how "natural selection" had stepped in, and perfected these local races. The dark New Forest and Perth races were, perhaps, the most melanic; another very distinct race occurred at Clevedon, whilst the palest local race yet obtained in Britain, came from the neighbourhood of Lewes. At Folkestone, it was widely spread, occurring by the roadsides, and being scattered over the Warren. The geological conditions

of Folkestone were not at all uniform, the Gault and Chalk both playing, however, a large part in the localities inhabited by this insect. The hedge-sides, too, with their peaty and leafy coverings, side by side with the bare chalk-hills, tended to preserve dark and light specimens somewhat indiscriminately, with the result that a sort of polymorphism was set up in the species there, of which, however, the palest rarely equalled the Lewes specimens, nor the darkest the Perth specimens, whilst a very pretty form with a dark central band occurred some years in fair numbers, and was rather remarkable. Mr. Tutt: specimens of *Zygaena exulans* from Braemar, Cogne and the Grauson Valley, all of which were referable to Dalman's var. *vanadis*; also specimens from Lauteret in Savoy, and from Lauzon in Piedmont; the Lauteret specimens were beautifully streaked with orange along the nervures, as were the Lauzon specimens with yellow. The extreme Grauson specimens were almost identical with the Lauzon specimens, yet, at the other end, they were inseparable from Scotch specimens. Mr. Battley referring to *Zygaena filipendulae* var. *cerinus*, said that this variety could be obtained at Lyme Regis, in one small spot, where it bred regularly every year.

Oct. 16*th*, 1894.—Exhibits:—Mr. Battley: a drawer containing most of his *Agrotidae*; also a copy of "The Photogram," having as a supplement a plate of colour photo-prints of *Chelonia caia*, *Vanessa io* and *V. atalanta*, the likeness to the originals being extremely good. Dr. Buckell: a ♀ *Epinephele ianira* and a ♀ *Satyrus semele*, both captured at Folkestone Warren, on September 2nd, last; the specimens were in perfect condition, and he raised the question as to whether the *ianira* was part of a second brood, or whether that species continued to emerge over a period of two months. Mr. Bate: a specimen of *Arctia fuliginosa*, bred from a ♀ taken at the end of June, the rest of the brood being still feeding. Dr. Dudgeon: a young slow-worm (*Anguis fragilis*) and its mother; the latter was captured at Herne Bay, and the young one was one of a brood of five; it was about five weeks old and very snaky-looking, being longitudinally striped with pale yellow. Mr. Clark: *Zeuzera pyrina* from London Fields. Mr. Southey: a long series of *Xylophasia scolopacina* from Highgate Woods, bred by himself, and preserved larvæ and ichneumons of the same. Mr. Smith: *Scodiona belgiaria* and *Asphalia ridens* from the New Forest. Mr. Bacot: a series of *Bombyx trifolii*, sembled near Liverpool; he remarked that the species did not seem to be very closely allied to any of its congeners, most of which he exhibited with their preserved larvæ. Mr. F. J. Robinson, of Brixton: an androgynous specimen of *Crocallis elinguaria*, bred from the New Forest. The antenna and wings on one side were distinctly male, and on the other side, female. Capt. Thompson, on behalf of Mr. Mutch of Hornsey: a series of *Agrotis cursoria* from Morayshire, N.B. He also exhibited series of *Agrotis vestigialis* from Co. Sligo and Pembrokeshire, and *Melitaea aurinia* from Co. Sligo; also an unset series of *Dasypolia templi*, taken at light by Mr. E. Halliday at Halifax, where he found them common, having obtained eighteen in this way. Mr. Bayne: *Hydrelia uncula*, *Tholomiges turfosalis*, *Hypenodes costaestrigalis*, and others from the New Forest; he reported the capture of both sexes of *Hybernia defoliaria* at Epping Forest, early in the month. Mr. Pearson: an onion stem, having about half-way up a small onion, which

had begun to grow in that position, when the seeds had commenced to develop. Mr. Tutt: *Emydia cribrum* from the New Forest, and for comparison its var. *candida*, taken by himself and Dr. Chapman, near Courmayeur, on the Italian side of Mont Blanc. Mr. Prout: *Tryphaena subsequa*, from Sandown and the New Forest; also *Noctua c-nigrum*, *Aporophyla australis* (with dark vars.) and *Caradrina ambigua*, from Sandown. Mr. Prout read the following notes:—

On Caradrina ambigua from Sandown.—"As the species exhibited to-night has already been recorded as *C. superstes*, it seems desirable to say a few words in explanation of my present announcement of it as *C. ambigua*. I am inclined to doubt whether our two British forms, that have been hitherto supposed to be, the one *C. ambigua*, and the other *C. superstes*, are distinct, indeed from what has come under my notice I feel sure they are not. It will be remembered that Mr. Tutt in 1889 (*Entom.*, vol. xxii., p. 235), recorded the Isle of Wight specimens as *C. ambigua*, but in 1891 (*Brit. Noct.*, vol. i., p. 148) he introduced *C. superstes* as also British, and referred the Freshwater specimens to the latter species. Looking at Herrich-Schaeffer's figures last Saturday, I felt no doubt that the insect I had taken at Sandown, and had received from Mr. Hodges from Guernsey, was the one there figured under the name *plantaginis* = *ambigua*; but, in order to get further light on the subject, I, this morning, visited the Natural History Museum, and examined the specimens from Zeller and Frey, which are in the collection there. These agreed with the testimony of Herrich-Schaeffer and all the other Continental authors, in that the more testaceous species was labelled *C. ambigua*, the more ochreous one *C. superstes* – exactly reversing Mr. Tutt's differentiation (*Ent. Rec.*, vol. iv., pp. 98–9). But *C. superstes* has the stigmata and the rows of transverse spots darker than in the figure (*l.c.*, No. 2, pl. c, fig. 4), of Mr. Tutt's Deal example, so that I suspect that even that is only a variety of the Continental *ambigua*. The true *C. superstes* has also a very distinct row of black spots on the margin of the fore-wing. Another little point that is not without significance is, that Fuchs, who knew both species well, and had reared *C. superstes* from the egg, says (*Stett. ent. Zeit.*, vol. xlv., pp. 261, *et seq.*) that *C. superstes* is single-brooded, and occurs contemporaneously with *C. taraxaci* in July, being worn by the middle of August, while *C. ambigua* is double-brooded, the 2nd brood being about from August 20th, on into September. This latter date agrees accurately with the time of appearance of most of our British examples."

Mr. Tutt, after referring to the original articles in the *British Noctuæ and their Varieties*, said that Mr. Prout's statement as to the more ochreous species being *C. superstes* and the greyer one *C. ambigua* was perfectly correct, and that this differentiation agreed with that in the *British Noctuæ*, &c., Vol. i.; the names were transposed in the Plate (c), and also in the short account of the species (*Ent. Rec.*, iv., pp. 98-9). It was, of course, quite possible that Mr. Prout might be correct in uniting the two forms, but without going fully into the matter, he did not think the two forms as described in *The British Noctuæ*, &c., were other than two distinct species, nor did he much doubt but that they were identical with the two European species. The matter, however, would have to be looked into. One thing was evident, and that was, that on the differentiation of the species, as proved by the original type

description in *The British Noctuæ*, the Guernsey specimens which had been captured, and most (probably all) of the Isle of Wight specimens, were *Caradrina ambigua*.

The Rev. C. R. N. Burrows of Rainham, then read the following paper:—

ENTOMOLOGY AT RAINHAM, ESSEX, IN 1894.

I feel that, before commencing to address you, I should offer some apology for appearing before you this evening, and disclaim at the very beginning any pretence of being able to *instruct* you in matters entomological. I must assure you, then, that I feel in the position of one pushed into publicity, and I should have much preferred to remain the "*mute*, inglorious Milton" I have ever been, and to have taken the seat of a listener, while someone better qualified than myself interested and instructed us upon the subject of the evening.

While disclaiming any right to lecture you in a learned or purely scientific strain, I may yet lay claim to a certain amount of experience in collecting, gained through a long course of years.

Though not born with a net in my hand, my earliest memories are entwined with entomology, for amongst the first things which I can call to mind, is a visit with two spinster ladies to Hounslow Heath, in search of *Anarta myrtilli*, when myself too young to join in that healthy but somewhat exhausting exercise.

You will not then, I hope, take me for a novice, but rather for what I really am, an *entomological dabbler*—perhaps I should say an unscientific collector—of long standing, whose spare time for a great number of years has been devoted, whenever possible, to discovering and recording the Lepidoptera which *can be taken* in the various localities where my life has been spent.

So far, I have been introducing myself and not the subject before us, but it is really this lifelong passion for collecting, which has been the cause of my appearance before you to-night.

All English entomologists (perhaps I ought to say lepidopterists) seem to have been complaining of this year, 1894, as having been a very bad one for our pursuit. My systematic hunt has resulted in putting into my hands a number of insects which, though not, perhaps, what can be called rarities, seem to me to have a good deal of interest; and as this belief seems to be shared by my entomological advisers, I have allowed myself to be prevailed upon to lay before you an account of my captures.

Rainham, the seat of my present investigations, is not itself a very inviting place. If any of you travelled to Southend in days gone by, or to Gravesend by Tilbury now-a-days, you will, I am sure, know the place. *It is the place for stinks.*

Here cabbages, onions and other vegetables are grown for the London markets; and here, also, the condemned fish from Billingsgate, the blood from Deptford, and the bones from everywhere, are worked up into manures. The sweepings of streets and markets, the dust and rubbish from contractors' yards, sometimes even the offal from the slaughter yards, all, I believe, make their way to Rainham, spreading their aroma far and wide, until they are converted once more into cabbages, and sent back whence they came.

But you must not suppose that you know Rainham from what you see from the railway line. The parish extends over a wide area. My boundaries extend three miles north-east and three miles south-east, while some two-and-a-half miles of the northern bank of the river Thames come under my care. This district embraces a variety of country. Towards the river, it consists of marshes, reed-beds and coarse-grass lands, with occasional saltings and mud-banks; while to the north and east, the land rises gradually and becomes more wooded. But even this higher land is not so productive as one would expect. The farmers fell what trees they dare, and the hedges are cropped down in the merciless fashion, which denotes, I believe, the presence of "high cultivation" and "scientific farming."

But be the district what it may, so far as actual collecting goes it interests me little. My occupation limits my efforts chiefly to the use of sugar. It is rarely that I get a chance of using the net. Happily I have a decent garden, and this garden I "sugar" regularly every night, from March or April to October, by which time I find that human nature refuses to set out any more insects, and my captures generally go either mouldy, or else hopelessly stiff. I sugar then regularly in my own garden, just beside the railway station (where, by the way, I notice sometimes that a whistle from a passing engine will startle insects off the sugar), and also, once a week, in a spinny some three miles away, which spinny is my nearest approach to a wood. Once or twice I have tried sugar among the reed-beds, with no result, save the very curious captures which will be noticed farther on.

Every night, during the months I have indicated, the sugar pot is brought out (usually by a small boy duly instructed in the art), almost every tree and post in the garden is smeared with the mixture, and the "round" is visited by me as early or as late as I can manage.

I use the coarsest, moistest, darkest sugar obtainable. All of you know, of course, what a difference there is in sugars. Like the nigger, they may be known *by the smell.* The ideal sugar, for our purpose, "Jamaica Foots"—so difficult to obtain now—being the lowest part of the contents of the hogsheads of *unrefined* sugar, was always to be known by its sweet *sugary* smell, but most samples now obtainable lack this, and I imagine, that they are either prepared from beet-root, or else have gone through some new process of refining, which has removed the nice, though it has certainly developed the nasty, odour. This odour is itself deceptive, for I have heard of an entomologist, who felt sure that the sugar which he used was the right, because it *smelt of feet.*

I mix the sugar with beer to the consistency of treacle, add methylated spirit (instead of rum), and a flavouring of oil of aniseed or essence of jargonelle pears (amylic acetate). I have tried the addition of poppy-heads and chloral hydrate to the mixture, hoping more effectually to stupefy the insects, but without much success, though I fancied that the poppy heads did quiet them a little; at any rate, this much is certain, that these latter additions do not drive the moths away.

A brother collector tells me that he once tried adding *gin*, and that he did not repeat the experiment, because he found that the insects fell from the trees and lay stupefied upon their backs on the ground before he could get round the first time!

I am certainly under the impression that change and variety in the way of scents and flavours prove an advantage, and that I have noticed

particular moths to frequent particular mixtures. This seems to me to be reasonable, because natural scents and flavours are various, and no doubt some prove more attractive than others. Yet I would most carefully guard myself against seeming to imply that I think that insects have the same idea of scents or stinks that we have. *Apatura iris* is said to like offal—I don't. My only serious attempt to capture his majesty, with a drowned pig and a rotten rabbit, certainly drove him away, if he was in the neighbourhood at all, and I don't blame him either. The French are said to "sugar" (!) with rotten decomposed soap-suds, and the largest catch of insects I ever saw, was made with a mixture of sugar and *urine*. And besides this, three years' residence in Rainham has taught me that if insects appreciated sweetness as much as we do, they would have used their advantage over men by flying away as fast as possible, and that collecting in the neighbourhood and for miles round would be perfectly useless.

I never consult temperature, wind or moon, agreeing with a correspondent that all depends upon the temper of the moths. Sometimes they won't come, sometimes they will, and I have found that, given the sugar, it does not much matter what the other conditions may be. The only condition which stops me is, when heavy rain, running down the tree trunks, washes the sugar off, and this difficulty I have partly overcome, by nailing pieces of board on to the trees, so placed that the running water does not pass over the sugar.

I must now pass on to my experience in the past season. My diary, which has been posted up with more or less regularity for a good many years, and which contains entries as far back as 1870, tells me that up to the end of May few things were about. During June, matters improved slightly, though the species taken were of the commonest, and the specimens few and far between.

On the last day of June (a Saturday, I remember, because being out of rum, I felt that it was not quite the thing for me to go either in person, or by deputy, into a public-house bar, on that particular evening) I first added methylated spirit to the mixture, and from that date fortune smiled upon me once more. Whether the novelty of the scent (a trace of paraffin oil), or a change in the weather, or a general agreement amongst the moths that *strikes were played out* led to this happy change I do not know; all I do know is, that with the use of methylated spirit my luck turned, and I had no longer to write in my diary "nothing at sugar."

It is unnecessary to say more about methods of collecting, therefore I will content myself with mentioning, *seriatim*, those amongst my captures which seem to me to call for notice. Specimens of most of these I have arranged in the two cases which I have brought with me to-night.

On July 5th, I took the first specimen of *Agrotis obscura*, a lovely specimen, the neat appearance, glossy wings, and bright red costa of which, both delighted and puzzled me. I had never seen the species alive before, and, like so many of my recent correspondents, I had only very poor specimens in my cabinet. I confess, without shame, that I thought at first that I had taken a curiously-marked *Noctua augur*, a mistake which was made the more excusable by the capture, the same evening of a very red specimen of the latter insect, the red tint being very much the same as that on the costa of the former.

I have very little doubt that I passed over several more specimens of *A. obscura* before I discovered what it was, and it was not until the 8th, three days later, that I noticed a second specimen.

The numbers taken on different evenings, ranged from 1 to 27, and the captures extended from the 5th of July, until the 6th of September. Two females, which I had boxed for eggs, escaped alive and well on the 11th of September, and I do not doubt but that, had they remained prisoners, they would have lived some time longer.

The species was most common in the last week of July, but did not show much trace of wear and tear until the end of August. I took in all about 120 specimens, mostly in good condition. How many escaped me I cannot say (some nights they were very lively, and flew directly they saw the light), and how many my cat ate I do not know; I got weary of them towards the last, and was not very much concerned when they got away.

In the case before you are 62 specimens, selected by Mr. Tutt as representing the chief points of variation. I notice that the typical *A. obscura* has the costa red, whilst the var. *ravida* has, in addition, a black mark between the stigmata. These two forms are, I think, well represented in the first and second columns. There seems also to be a tendency to the development of the complete transverse lines on the upper wing which occur in several other *Agrotides*, and some very distinct specimens of this variety are in the third column, while the fourth column shows the forms which incline towards general suffusion and obscurity. A few specimens show also the development of a ladder-like series of lines between the elbowed and subterminal lines, which will also be very distinctly seen in some of the forms of *A. nigricans*, to be noticed later on.

After several failures, I succeeded in getting a good many eggs. These do not promise well; at first yellow, they have now turned leaden black and have lost their form. This is not, I know, a proof that they will not hatch, for I have before noticed eggs, notably of *Orthosia suspecta*, which seemed to shrivel up and flatten till they lost all shape, but, after all, hatched in due course. That these eggs are not simply infertile seems to be certain, because there are (as is usual) a few infertile ones which still retain their yellow colour.

The next species which I will refer to, is *A. exclamationis*. Though so common, I think that it is well worth examining for variation. Looking over the 62 specimens in the case before you, I feel that I cannot say that the majority are much out of the common, though they were all taken on account of some peculiarity. Many of them exhibited when alive a distinct redness of costa (again recalling *A. obscura*), but I must acknowledge that I don't see much of it now that they are dry, though here and there I think it may still be traced.

The most remarkable are the five in the third column with united stigmata, particularly the one with the scorched appearance of the fore-wings. There are also two with the outer half of the fore wings clouded with a darker shade, giving them a very strange and distinguished appearance, as though related to *A. ashworthii*. I have remarked the same tendency in *A. obscura*, but it is, I suppose, unusual in both species. One specimen seems to me to be remarkably dark, and curious from the entire absence of all red tinge. The malformed specimen at the bottom of the first row seems to deserve attention, inasmuch as the slit in the

right hand fore-wing is fringed all round, and the claviform, placed upon the abnormal lobe, is double. Were it not for this position of the claviform, one could almost persuade one's-self that the insect possessed a fifth wing.

The infinite differences in the form and development of the stigmata, the difference in length and width of the claviform, the almost total absence of both orbicular and claviform, and the smudged appearance of the reniform, are all noticeable, as well as the ladder-like series of lines between the elbowed and subterminal lines. The pale central area of the wing is also, in some specimens, reduced to a mere dot placed between the stigmata.

I have placed in the same case six specimens of *A. segetum*, on account of remarks which visitors have made about them. These black females I have always taken freely, and I should like to hear to-night whether other collectors have also found them common. For myself, I cannot help thinking that the reddish unicolorous specimen at the bottom is the more remarkable.

I come next to 124 specimens of *A. nigricans*. I may be pardoned, perhaps, for the confusion which I experience when I try to arrange them in order, and far more when I attempt to describe them, more particularly because I have neither taken nor noticed such varieties before.

A series of six, placed in the last row, represent the pick of my takings in 1893, and it is curious to remember that one or two of them suggested *A. obscura* so strongly, that I had actually entered them in my diary as that species, with a query intimating my doubt. At that time, I did not possess a specimen of *A. obscura* to refer to, and was guided entirely by Newman's figure which you will all remember. I imagine that the distinct transverse lines in that figure led me astray. I was again deceived in the same manner this year by a specimen in the fifth column, which occurred with *A. obscura* and actually got mixed up with that species as a small specimen, and when you look at it you will, I think, agree that I was justified.

The variations of *A. nigricans* seem to me truly remarkable. I knew nothing of the species three years ago. Common though it is generally considered, I am convinced that if a correspondent had sent me a few years since as *A. nigricans* some of the varieties in my case to-night, I should have put him down for an ignoramus and myself (of course) for a wise man.

The differences of colour, no less than the differences of markings, are confusing to a degree, and one can see but little likeness between the almost brick-red form with yellow markings of the first, and the almost totally black of the last, between the almost spotless reddish-grey, and the finely-marked greyish-black.

The last four specimens of all appeal to me most strongly, and I think they "take the cake," both for coloration and for delicacy of pattern. I do not possess even one specimen of *A. agathina*, but imagine that these pretty little forms approach that species.

With a series like this before me, one feels the (almost) absurdity of Newman's solitary figure, and also of Stainton's six-line description:— "F.-w., dull-dark brown, clouded with black, sometimes of a reddish tinge; the more conspicuous markings are, a short blackish streak from near the middle of the base" (which, by the way Newman says, looks as

though it had been scraped with a knife); "a black spot before the orbicular, a rhomboidal black spot between the stigmata, orbicular sometimes pale, reniform always so, especially its hind margin."

One cannot help feeling, in the face of such variations as these (and *A. nigricans* is by no means alone), that we are indeed still in the fog, if we longer content ourselves with speaking of a light or a dark, of a red or a black, of a streaked or a blotched, so-and-so. Possibly some of my correspondents would be glad of some of the forms before us to-night, but how on earth are they to acquaint me with their wants, unless the forms have a name. Can we not come *to an agreement* to name varieties? It is done in some cases not nearly so necessary as this. "A black *Amphidasys betularia*" would convey a clear intimation of what was in question, as would "a dark *Miselia oxyacanthae*," but to speak of a red, a grey or a black *A. nigricans*, by no means meets the necessities of the case.

Besides being here so often reminded of *A. obscura*, I also find myself in some doubt as to where to draw the line between some forms of *A. nigricans* and *N. xanthographa*. You will, perhaps, smile and say to yourselves, why! the form and the structure forbid such a mistake. But *N. xanthographa* has sometimes narrower wings, and I have seen specimens (one of which, though a poor one, is in the case) which run so very close, that I do not like to decide for myself to which species they belong. And this is especially the case, where the white hind wings of the male *A. nigricans* have only a faint lunule but still possess the well-developed marginal band which we associate with the male of *N. xanthographa*.

I come now to a few other species taken this year, which seem to me to be somewhat out of the common. First, are four specimens of *Xylophasia monoglypha*; the pale one, bred; the three dark forms taken at sugar. The last specimen seems to me to be most interesting, for the reason that, although as dark, or nearly so, as the northern forms, it yet retains the pale spot on the inner margin, which occurs in the type.

Then I will ask you to notice a short series of *Anchocelis pistacina*, ranging from yellowish-brown to a fine red, the former colour appearing to me to be most curious; another series of *A. lunosa*, their colour varying from yellowish, through a decided red, to grey and even black; two specimens of *Noctua baia*, the first red, which I take to be the ordinary form, the second purple, which almost suggests *N. stigmatica*, but is without the rhomboidal dark mark between the stigmata characteristic of the latter species; one or two specimens of *Caradrina cubicularis*, which seem to be much darker than usual, a form which appears to have been rather common with me this year; lastly, a row of *N. xanthographa*, some red, and three very curious silvery-grey specimens which I take to be unusual.

Having gone through my exhibits, which I hope will at least interest some of the less experienced of your members, I may, perhaps, unless I have already taken up too much of your time, mention a few more species which I either have or have not taken at Rainham. First of all, the genus *Cerura* (*vinula* and her sisters), seems to be entirely absent, although poplars, willows and sallows, as is natural in such a marshy place, abound. *Gonepteryx rhamni* I have not caught sight of in three years, although a single *Triphosa dubitata* told me that there must be buckthorn within reach. *Dasychira pudibunda* must be very rare; a single larva found last week, alone proving its occurrence. None of the "sharks," except *C. umbratica*, occur.

I have taken single specimens of the following species, and cannot account for their presence, unless it be that, as travellers, they were, perhaps, trying to find out what sort of a place Rainham was, and if it be so, they have every reason to be dissatisfied :—

Dicycla oo, a species dear to me, of which I have had 80 specimens on the boards at once. There is scarcely an oak near. *Orthosia suspecta*: there is but one birch tree for miles. I suppose that, although the books say of the larva "food-plant unknown," most of you know that it will feed up on birch. These two species are those to which I referred as being remarkable, inasmuch as they were the only captures worth noting taken in a reed-bed.

Two *Xanthia gilvago*, one last year, and one this. I am not so much surprised at taking this insect, as at not having taken more, for elms are common enough. *Phibalapteryx vitalbata* (at sugar); there is no clematis within three miles. *Drepana falcataria*. Remember the absence of birch. *Erastria fasciana*: taken flying, at 8 a.m. in my garden; of interest to me, because Newman says this species is common in the bogs of Killarney. I have only seen it in woods. A *Geometra papilionaria* must also have felt disappointed to have found no birch.

Larvæ of *Acherontia atropos* are fairly common. Last year I had five and reared three. This year I have had eight, none of which have produced moths so far.

Apamea ophiogramma is an insect which everybody seems to want. It was very rare at Brentwood, where I lived for six or seven years previous to settling in Rainham. I had no sooner got into the latter place, than I began to look about for means of enticing it into my garden. The striped ribbon-grass is a well recognised lure, and of this I found that I possessed one stunted specimen, growing in a stony path. I divided this, and, as is its habit, it increased and multiplied. The first summer, I got no *A. ophiogramma*; in 1893, I secured seven, and this year, twelve, between July 6th and August 15th. I have now large quantities of the food-plant growing, and hope next year to succeed in rearing some in captivity.

But what a difference there is between catching *A. ophiogramma*, and possessing specimens good enough for one's cabinet, if one is particular. How often what one thought good at first sight, fails to satisfy after it is set out. I am inclined to think that this, with some other species—such as *Rusina tenebrosa*, &c.—require much more careful handling than the majority of insects (the scales seem to be more loosely fixed), and I now kill *A. ophiogramma* with oxalic acid, and set it with the least possible delay.

A. saucia seems to have been entirely absent from Rainham this year, for I have not seen a single specimen, good or bad. The local form is a beautiful one, being much clouded with light grey, and the specimens are considerably larger than those which I have been accustomed to meet with elsewhere.

A. lunosa has been very abundant on sugar this year. One seems to have taken it more frequently at light, and I find a note that the first time I ever saw it at sugar, was on September 27th, 1892. Perhaps it is a case of acquired taste, which has become hereditary.

I took a specimen of *Hadena thalassina* at sugar, on Sept. 4th; Stainton gives June and July; Merrin, May, June and July; Newman, May and June. I bred *H. suasa* (one out of a number of pupæ), on the

15th of August; Stainton gives June; Merrin, May, June, and sometimes, August; Newman, June.

A friend took a single *Zygaena filipendulae*, at Southend, on the 4th of September; I myself took one at Penzance, on August 11th, 1890; Stainton gives June and July; Merrin, June; Newman, June, beginning. I found a freshly-emerged ♀ of *Metrocampa margaritaria*, sitting on a grass-stem at the foot of a tree, on the night of Sept. 5th; Stainton, gives July; Merrin, June and July; Newman, July. I find I took a specimen at light on the 30th August, 1893.

A friend writes me that he was taking *Agrotis tritici*, on Sept. 14th, of this year; Stainton, gives August; Merrin, July and August; Newman, July. I took *Leucania impura* a week ago.

Some of these are doubtless instances of partial second broods; some, perhaps, cases of the survival of the fittest, most vigorous, and latest developed. One can understand that, when an insect's period of flight covers perhaps a month, some individuals may be delayed some little while beyond the rest, and some of these may live long beyond the time of those first developed. Or, a change of weather, when the larvæ are feeding, may check the growth of some, kill others, and perhaps, not affect the remainder, who may have got beyond the stage where the check can be felt. In confinement, the larvæ which lag behind the others generally seem to me to die, but in a wild state, they may possibly pick up again, and go through their changes successfully, and, possibly, in solitary grandeur. In the year 1886, I found on June 3rd, a magnificent ♀ *Saturnia carpini*, evidently just emerged, a month late at least.

One last word to those who, like myself, hope against hope, for a grand catch of rarities—people who have seen *Vanessa antiopa*, but have not caught it. May it not be that we, who call ourselves the unlucky ones, are to have our luck amongst varieties, instead of amongst species? I suggest, of course, that there must be varieties of common Lepidoptera which are as rare as *V. antiopa*, as rare, perhaps, as *Valeria oleagina*, and some varieties may prove to be unique. If luck does not favour us one way, it may another. The very commonest species may produce a prize. How many have been cheered and gratified by a grand var. of *Arctia caia*, or of *Abraxas grossulariata* (I once threw away a whole brood of semi-transparent specimens of the latter species, only troubling to set two, to show how *wretched* they were). A great friend and I once could get nothing by beating but larvæ of *Cabera pusaria*. *He bred from his lot a moth which was entirely grey.* I sent the same friend, from Cornwall, a number of larvæ of *Spilosoma menthastri*. He bred from them some melanic forms, which, to say the least, are not to be picked up every day, and which fetched a good price when he sold them. I must conclude, by thanking you for your kind attention, and by another humble apology for the imperfections and commonplaces of my paper.

Mr. Tutt proposed a hearty vote of thanks to Mr. Burrows for his paper. He stated that, strangely enough, the first specimen of *Agrotis obscura* he saw on sugar, almost deluded him into the belief that the insect was *Noctua augur*. The longitudinal streaking near the outer margin of the wing seemed to be quite a general (although rare) character among some Agrotids. Referring to the unusual variation that Mr. Burrows had found in *Agrotis exclamationis* this year, he remarked that excessive variation in this species appeared to be

somewhat connected with meteorological conditions (probably extreme wetness), as he found the species to vary remarkably in the wet and cold summer of 1888. The peculiar aberrations in shape which frequently occur in this genus had previously been discussed, and malformations appeared to be not uncommon in many Agrotid species. *Xylophasia scolopacina*, as seen in Mr. Southey's exhibit, had a mottled form exactly parallel with *X. hepatica* var. *characterea*. Visitors at sugar, who appeared as poachers, were now a rather numerous family—mice, toads, frogs, &c. The series of *Agrotis nigricans* exhibited, was a very fine one, and illustrated well the range of variation which a polymorphic species could attain in a single season in a given locality. The vote of thanks was carried by acclamation.

Nov. 6th, 1894.—Exhibits:—Mr. Nicholson: a series of five ♂ and four ♀ *Trichiura crataegi*, bred from twenty larvæ, beaten from blackthorn in Epping Forest; the remaining eleven were either cripples, or were sacrificed for ova, of which he obtained about 200. Mr. Clark: a brownish specimen of *Vanessa urticae* from Tottenham. Mr. Bate: *Boarmia repandata* var. *conversaria*, and a fine banded form of *Oporabia dilutata*, from the New Forest. Mr. Bacot: *Colias electra* and var., from S. Africa, with *C. edusa* for comparison; the variety closely resembled *C. edusa* var. *helice*, but was much suffused with blackish. He also exhibited 84 specimens of *Orrhodia vaccinii*, which varied a good deal in colour though the female parent (also in the box) was of a uniform purplish-brown. Mr. Southey: some very fine specimens of *Acheta domestica*, the house-spider, one of which had legs measuring about $2\frac{1}{2}$ inches in length. Mr. Tutt: a box of Lepidoptera (mostly Rhopalocera) from Grésy, near Aix-les-Bains, representative of those caught during a stroll on the morning of Aug. 21st, and comprising among others *Satyrus dryas* (both sexes), *Hipparchia arethusa* exhibiting considerable variation in the depth of the orange colour and extent of the transverse band, *Colias edusa*, *C. hyale*, second brood of *Leucophasia sinapis*, *Pieris daplidice*, *Argynnis latona*, *Melitaea cinxia*, *M. athalia*, *Lycaena argiades*, *L. bellargus*, *L. corydon*, *Satyrus briseis*, with a fine male variety of the latter, in which the central band was much restricted and clouded with fuscous, together with many other species. He exhibited also *Zygaena carniolica*, and vars. from Courmayeur and other localities in Savoy and Piedmont, on which he read notes relative to their habits and variation. Dr. Sequeira exhibited samples of wood naphtha, and Mr. Clark applied some to the bases of the wings of a dry specimen of *Spilosoma lubricipeda*, with the result that in less than five minutes, the specimen was sufficiently relaxed to allow of its being reset. Dr. Sequeira extols the virtues of the spirit thus:—

A RHYME OF RELAXATION.

It's bother'd many an Ento' when he's had a valued moth,
With wings set unsymmetric'ly, how best to get them both
As even as a plumb-line, without the laurel jar
Or sand that's wet and mucky—too troublesome by far.
I'll give you my experience of something new and strange,
That's said to do just all you want, within a certain range.
You get some *pure* Wood Naphtha—"syn" Pyroxylic Spirit,

And then you get a tiny brush and dip the end within it.
You next take up your lovely moth by the pin that's through his chest,
And turn him straightway upside down, and so expose his breast;
Most carefully the brush apply, unto each shoulder joint,
Let it soak in, for minutes three, the parts that you anoint.
You now must take the little moth, and pin him straight and smooth
Upon a proper setting board, the body in the groove.
Then, with a needle fine and curved, you raise his little wing;
You'll find it move quite easily, you'll say it's just the thing.
'Tis best to put a bristle on while you are at the work,
And last of all you brace it down—the wing will never shirk.
When four and twenty hours have passed, you take it off the board
And place it in your cabinet, its symmetry restored.
I've tried it on *Pronuba*, that was very old and dry,
And *Polyodon* also, whose wings were all awry;
And now they shine resplendent, with wings both straight and true,
I hope that these instructions will act the same with you.
But whether unset specimens will answer in this way,
I really cannot tell you, and history doesn't say.

Nov. 20th, 1894.—Exhibits:—Mr. Battley: *Anchocelis pistacina* and *A. lunosa*, showing the strong resemblance between the species. The most evident difference in the specimens shown, lay in the subterminal line, which, in *A. pistacina*, consisted of a series of crescentic spots, similar in colour to that of the wing, whilst in *lunosa* these spots were *black*. Mr. Clark: *Taeniocampa gracilis* from the New Forest, one specimen being light reddish, and the other dark purplish-brown. Mr. Bacot: *Gortyna ochracea*, bred from burdock-stems from Ponders End; two of the specimens had a light blotch on one of the fore wings, which Mr. Tutt believed was caused by pressure on the pupa during development. Mr. Prout: *Orthosia lota* from Hale End and Sandown; the former were all typical, the latter nearly all var. *rufa*. Mr. Tutt: *Zygaena achilleae* and vars from Courmayeur, Piedmont. Mr. Battley gave a short account of a recent visit to Charmouth, Dorset, from which it appeared that although Lepidoptera were scarce by reason of the inclement weather, 111 species of plants were observed which were actually in flower; these included the primrose, cowslip, dog violet, wild strawberry (also in fruit), and privet. The principal insects captured at ivy were: *Xylina socia* (one, about the middle of November, in perfect condition); *Epunda nigra* (5, three of them bad); *Orthosia macilenta* and *O. lota* (mostly var. *rufa*), also a few *Xylina rhizolitha* and *Cidaria siterata*; two specimens of *Dasypolia templi* were taken at light at Lyme Regis on November 5th, and one specimen of *Pararge egeria* was seen on October 25th, on which date, *Orrhodia vaccinii* began to appear.

The following gentlemen were nominated as Officers of the Society for 1895:—President and Treasurer, Mr. J. A. Clark; Vice-Presidents, Mr. J. W. Tutt and Dr. Buckell; Curators, Messrs. Bayne and C. B. Smith; Librarians, Messrs. Gurney and Prout; Secretaries, Messrs. Nicholson and Battley; Council, Messrs. Lewcock, Newbery, Oldham, Bacot and Capt. Thompson. Mr. Bacot and Mr. Prout were appointed Auditors for 1894.

Annual meeting, *Dec. 4th*, 1894.—Exhibits:—Mr. Battley: *Xylina socia*, *Epunda nigra*, *Cidaria siterata*, *Orthosia lota*, *O. macilenta* and *Dasypolia templi*, all from Dorset. Dr. Sequeira: *Paraponyx stratiotalis*, *Spilodes palealis*, *Hydrocampa stagnalis*, and *H. nymphealis* from Folkestone. Mr. Prout: *Noctua plecta* and var. *andersoni*, Lampa, *N. glareosa* and var. *rosea*, Tutt, and *N. rubi* and var. with transverse lines obsolete, all from Sandown. Mr. Taylor: a variable series of *Orthosia suspecta* from Wimbledon, and a fine specimen of *Xanthia ocellaris* from the same locality; only some half-dozen [? only two, Ed.] specimens of the latter have been recorded for this country. Mr. Bate: two specimens of *Danais chrysippus*, which had been satisfactorily reset, after having been relaxed with wood-naphtha. Mr. Clark: *Hypochrysops delicia*, a rare butterfly, and *Selidosema lyciaria*, a beautiful moth, which appeared to be much more closely allied to *Boarmia* than to *Selidosema*; these two good species were captured recently by Mr. E. Anderson, at Melbourne.

All the gentlemen nominated at the last meeting as officers for the ensuing year were elected, except Dr. Buckell, who declined re-election; Mr. F. J. Hanbury was elected Vice-President in his stead. Captain Thompson, however, became Curator, and Mr. C. B. Smith was elected on the Council.

The Secretaries' Report for 1894 showed, that although the average attendance had fallen off somewhat, yet the papers, exhibits, &c., were, if anything, rather above the average; the membership roll was practically stationary.

At the invitation of the President (Mr. J. A. Clark), Mr. Tutt read the following address, in the place of the usual presidential discourse:—

ADDRESS BY THE VICE-PRESIDENT TO THE CITY OF LONDON ENTOMOLOGICAL AND NATURAL HISTORY SOCIETY.

It is difficult to know what subject to select for an address to a body of entomologists at an annual meeting. There are two things, however, which perhaps, beyond all others, interest every entomologist; these are—our subject and ourselves, and to these I will direct your attention.

The study of entomology, like that of almost all the other sciences, has been a matter of very slow growth. Carried on by a few enthusiasts, usually living far away from one another, entomology was at first considered as only a branch, and a very unimportant branch, of natural history; but during the present century the subject has been taken up by an ever-increasing number of students all over the world. The first three-quarters of the century were occupied more especially in the systematic arrangement and correct naming of specimens, but the last two decades have seen a great advance in the study of the philosophical side of the subject, and this is due in a large measure to the tremendous impetus given to the philosophical study of natural history by Darwin.

During this latter period, the old manner of studying entomology has to a great extent died out. Entomologists, in the exact meaning of the term, may be said hardly to exist now. The subject has become so wide and comprehensive, the material collected so vast, the impossibility

of any one student ever grasping the details of the whole subject so evident, that entomologists have long since given place to dipterists, coleopterists, etc. But, even though a man may become a proficient systematic dipterist or lepidopterist if he have leisure and ability, yet, as a rule, the study of an entire Order, if the study is to be really worthy of the name and to be something more than the mere naming of specimens, is soon recognised as impossible. Accordingly, we frequently find men who restrict their attention to one small family of the larger Orders, and all their energies are needed to deal with even this small part of the subject.

Almost every scientific entomologist, however renowned he may afterwards become, began his career as a collector either of butterflies and moths, or of beetles. Darwin was a keen collector of British Coleoptera, as a lad; McLachlan, the great authority on dragonflies, revelled in butterflies and moths, and I believe that the Lepidoptera were Sir John Lubbock's first love. It is from collectors of this kind that our scientific naturalists are made—men who understand the living creatures they study, and who are not misled so easily as are those to whom the dried bodies alone are of interest. It must be borne in mind, that on the younger generation of naturalists—lads now actively pursuing Red Admirals and Clouded Yellows—will devolve the carrying on of the work which we of the present generation are now doing our best to further and to consolidate. It is the duty of our Societies and of their individual members to foster a love of natural objects, and to direct it, if possible, into channels where it will bring forth good fruit.

It has long been a popular opinion that an entomologist is a person who collects insects, rather than one who studies them. That this conception is based, even now, not so much on prejudice as on real observation of the ways and customs of so-called entomologists, is only too sadly evident. How many of our lepidopterists know anything of the anatomy of insects? How many know anything of the wonderful organs by which the small insect, which they ruthlessly pinch and thrust out of the net because it is not sufficiently fine for the cabinet, sees, tastes, smells and probably hears; or of the way in which the honied drops, distilled in Flora's dainty recesses, are converted into the blood, muscles and other parts of insect structure; or, how the crawling caterpillar becomes metamorphosed into the charming fly, beetle or moth, which so interests us?

The collector of insects in times gone by appears to have supposed that the science of entomology consisted in systematic arrangement; but since that time a vast field has been opened up to thoughtful entomologists, a field unknown and unthought of by the old school of collectors and collection-makers. The systematising stage in the evolution of our science was, however, a very necessary one, for until we have approximately correct and complete lists of the insects of different countries, their comparison is impossible. Only when this work had been done, could the more philosophical side of the study be taken up with any advantage. Collections of insects are, indeed, the storehouses of the facts on which philosophical naturalists can build up theories, make deductions, and speculate with some remote possibility of certainty on the dim vistas of the past which rise up spectral-like to haunt and yet to fascinate the enquiring mind.

I would not have it supposed for a single moment that I think the work of the systematist is finished; on the contrary, a vast amount of systematic work yet remains to be accomplished. It has been calculated that about 2,000,000 insects exist, of which only some 200,000 have as yet been described, so that there is still plenty of room for the collector and for the species-namer. We cannot say, however, that the student of insects allows the collector of insects now-a-days to have it all his own way quite so much as was the case some forty years ago. Writing in 1856, Sir John Lubbock says:—"I find that in the last four volumes of the *Transactions of the Entomological Society of London*, 818 pages are devoted solely to description of species and genera, while all the other departments of the science occupy only 244, of which 208 treat of the habits of insects, and there is not a single paper on physiology or internal anatomy." If the last four volumes of the *Transactions* of the same Society contain but few articles on the physiology or anatomy of insects, it must at the same time be admitted that a comparatively small amount of space is given to the descriptions of new genera and species, whilst a comparatively large amount is devoted to experimental entomology and philosophical deductions therefrom. In fact, students now are breaking up rapidly into systematists, who still continue to describe genera and species, and biological entomologists, who combine with their biological studies a study of the relationships of the insects to one another and to their environment. With the general spread of scientific education during the last quarter of a century, there can be no doubt that a large number of entomologists, who, in the days when Sir John Lubbock penned the above extract, could never possibly have hoped to be anything more than collectors, or, at the most, systematists, are now really good and earnest scientific students.

Of all the Orders that come within the ken of entomological science, the Lepidoptera have furnished the greatest amount of material for philosophic study. The coleopterist still works away at his species; but scarcely any coleopterist of repute has written a deeply philosophical paper on the Order which he has made his special study. The marvellous habits of ants, bees and social wasps have brought the hymenopterist to the fore, but the students of the other orders rarely write anything of general interest. The young and well-educated individual, who to-day takes up the collecting of Lepidoptera as recreation and study combined, usually puts enough energy into his work to name the Macro-lepidoptera of his native country in two or three years, and the Micro-lepidoptera in three or four more, and then he usually commences to look about for varieties. True, one here and there may do this from the most mercenary and unworthy motives, and with no desire to learn what the diversities and differences expressed by variation mean, just as he *may* have collected Macro- and Micro-lepidoptera without wishing to understand their habits, anatomy or physiology. But, in such cases, the collections are the end instead of the means, and we, I am sure, shall all agree with the sentiment expressed by Sir John Lubbock, that "to collect merely for the sake of collecting, has a direct tendency to narrow the mind. To aspire only to be able to say that one has in one's cabinet a certain number of species, or some rare sorts which nobody else possesses, is surely an ambition quite unworthy of a true entomologist."

Although collecting, then, must always be considered as a legitimate part of an entomologist's work (nay, up to a certa inpoint, as a neces-

sary and important part), yet if a person's pursuit of entomology stops short at collecting, he is about as much a scientific entomologist as a butcher is a comparative anatomist or a physiologist. In the pursuit of his study the entomologist will find a great part of his material in the living insects which are the objects of his tender care and solicitude. The habits of species may be well known, but what relationship do these habits bear to the environment of the species? The colours of larvæ may have been well-described, but what is the meaning of a particular mark or a particular spot? The differences between two closely allied butterflies may have been very carefully worked out, but what has brought about these differences? Two different forms of the same insect may be known, but what is the cause of the difference? The polymorphism of a moth is exceedingly interesting, but what inherent factor has produced the polymorphism? And here even the best stop at present. What are the inherent factors that produce, determine and guide the forces which result in variation? We theorise; we think that we have solved a puzzle, only to find that some one detects an error in our data, a defect in the foundation of our theory, and down comes the super-structure to the ground. But destructive criticism is much easier than the formulation of a new theory to put in the place of what we destroy. Nevertheless, we find, in spite of the searching criticism to which every new theory is subjected, that a great deal of solid headway has been made. When a man observes a phenomenon, his first question should be—What is the cause of it? When he attempts to answer the question and starts his theory he must ask himself—Can I knock a hole in the bottom of it? If he cannot, and if other scientific students cannot, then the theory must stand as an explanation of the fact until something better can be put in its place. This, in truth, is the basis of all scientific study, which makes men, if they will, find—

> "Books in the running brooks,
> Sermons in stones, and good in everything."

The excellence of British collections of Lepidoptera has always been conceded, and the extent of the insect fauna of the British Islands, in comparison with that of other countries of equal or greater area, is very noticeable. The known Tortrices of the Palæarctic area, total up to about 650; of these, above 350 are British. Almost 50 per cent. of the known Palæarctic Tineina (taking this group in its old and widest sense) are to be found, and so on. We have in Britain two-thirds of the number of insects to be found in the whole of Germany and Switzerland combined. It is not at all difficult to understand why this is so. No country in the world of equal area presents the same diversities in its geological characters as do the British Islands, and I need not point out how intimate is the connection between the geology of a country and its flora, and between the flora and the insect fauna. The varying geological conditions give us a flora, large both in the number of genera and relatively in the number of species, and this is sufficient to account for the fact that we have so large a percentage of the Palæarctic insects existing in our midst. This fact helps to explain why the insularity of British entomologists has never been so fatal to their scientific aims as would have been expected, and at the same time, why a thorough study of the British fauna has often formed an admirable education for those who have afterwards made their names as entomologists or naturalists of the world.

This variety of geological conditions has combined with the isolation of the British Isles as a whole and the still greater isolation of some of the smaller islands, to give us a fauna unequalled, probably, in its range of variation, by that of any other part of the Palæarctic area. The combination of two strong influences—that produced by natural selection acting on differences of environment (geological), and that produced by isolation—has resulted in the variation of many species which in other parts of the Palæarctic area are but little subject to change. These varietal differences were but little noted until a few years ago; but the writings of Darwin have largely changed this, and our learned biologists of to-day have gathered from a study of the variation of insects the facts on which have been founded some of the most important theories that have ever yet been formulated by the human mind. Wallace, Weismann, Poulton and others are essentially entomologists and biologists combined, and we all know how large a place entomology takes in their work. The ease with which insects may be obtained, and the rapidity with which generation succeeds generation, make them particularly suitable subjects for experiment, and this is sufficient in itself to explain why there is such a strong tendency to rest the proof of the theories advanced on the facts connected with our favourite study. But this phase of our subject leads me again to point out what a gap there is between those people who collect for the mere sake of collecting, and those who study what they collect. The latter, if I may so put it, have passed from ignorance to knowledge, from darkness to light. Can anyone tell the vast gulf that has been bridged here, or how greatly the enjoyment of life has been increased? Can anyone define the exquisite change of feeling with which an entomologist regards an insect once the barrier has been passed?

I have before pointed out the value of collections, and therefore the *bonâ fide* position of collectors. I have shown how necessarily limited is the range of the collector compared with the whole field of natural science. I have suggested that a collector may be a mere cumberer of the ground, but have also indicated how, under favourable conditions, he may take a humble place among the scientific workers of his age, and aid in unravelling some of the many tangles and puzzles, the many mysteries of Nature which everywhere surround us.

This leads me at once to the value of entomology as a subject of study. There are people who think that the only value of a thing is the money that it will fetch, utterly forgetful that money itself is only of use in so far as it adds to happiness. The value of the study of a scientific subject cannot be gauged in this way. An old philosopher once said, "Whatever it has been worth God's while to create, it must be worth man's while to study." The mental pleasure which the subject gives must be the rule by which its value is measured. The constant and continuous pleasure afforded by entomology, the industry required in separating the wheat from the chaff in the more philosophical branches of the subject, can be pointed out as bringing about a condition of mental happiness, of which nothing can rob us and to which only an individual of the highest mental type can attain; then one may add the health-giving exercise necessitated by field work, the mental and bodily exercise combined tending to produce the coveted "*mens sana in corpore sano*." Indeed, the charms of entomology are such, that one wonders not so much how it is that many with a love of

investigation, or curiosity as to how the present natural conditions have been brought about, have taken up seriously and enthusiastically its study, but rather, considering all things, how few there are who have done so. Once the true course has been opened out before our eyes, and the true philosophical spirit tasted and appreciated, the charm and interest are unequalled.

Probably, the fact that average men and women look upon us as a body of somewhat harmless lunatics, has had something to do with the slow progress that entomology, in company with other branches of science, has until recently made. That any sane man or woman should be interested and, as the uninitiated would say, should "waste his or her time" over bugs and insects, appears unaccountably strange to many. The fact that when much-read writers endeavour to portray an entomologist, they generally idealise him as being widely different from other men, totally immersed in his subject, and stupid to the highest degree in all matters else, has probably had much to do with the popular fallacy. On the other hand, the stupid ignorance which so-called educated men display; the absurd blunders and errors into which they fall; the ridiculous errors which high-class papers and magazines allow to pass unchallenged in their pages; all these lead scientific men to wonder oft-times whether such people are not really deficient of a certain section of their brains. These frequent errors, too, appear to be so utterly beneath contempt, that the well-informed man allows them to pass unnoticed, knowing that to correct them he must explain to adults as he would to little children. The task appears so Herculean that he desists from the attempt.

Whatever depths of general ignorance still exist in the popular mind on matters entomological, it must be owned, however, that the interest recently exhibited in the more philosophical side of the study, together with the general spread of education and intelligent culture, have left their mark, and we are glad to find that many individuals do now-a-days express their surprise at the prevailing ignorance about natural history matters. Some such have suggested that, in its simple forms, natural history should be made a compulsory subject of instruction in the State schools. I suppose there is no Oxford or Cambridge graduate, a master in one of our Public schools, who corrects a boy for telling him that a whale is not a fish; nor perhaps is there a certificated teacher in our State schools, who would be guilty of the same or a similar error. With regard to that still great army of "private adventure" schools, however, on which Max O'Rell so glowingly descants, those "seminaries for the sons and daughters of gentlemen," which compare so unfavourably in their results with their compeers, can as much be said? As a teacher, however, it is my most decided opinion that the making of such a subject as natural history compulsory in our State schools would be ridiculous in the extreme. Our system of primary education, compared with what intelligence and a little insight might make it, is now (owing to the superfluity of subjects which have been rendered compulsory if the maximum Government grant is to be earned) largely a huge sham. Interest a lad in pond life, by showing him the marvellous wonders, the thousands of tiny inhabitants that a drop of such water contains; show him the beauties of a butterfly, its marvellous tongue, its wonderful eyes; and if he has any taste in this direction, depend upon it the taste will soon exhibit itself.

Some little thing or other made most of us active naturalists. At the age of thirteen, a friend called one day and asked me to go and see a case of butterflies made by a youngster a year or two older than myself, who had just come up from Newbury in Berkshire to my native town. I went; the next day my mother lost a window-blind, and I bought a cane. In this way, in 1871, I provided myself with my first net. Large pins, small pins, anything that would spike a butterfly or moth, were brought into requisition. I became the nuisance and horror of an orderly house. At the age of 15 my craze had become a settled form of lunacy, and everyone was enjoined to leave me in peace. Of books I had Coleman's *British Butterflies*, Wood's *Common British Moths*, a few odd numbers of Stainton's *Manual*, and afterwards to complete my treasured library, Newman's *British Moths*. How I cherished that book! Living within three miles of Chattenden Woods, and within twenty minutes' walk of the breezy chalk downs and the charming oak and beech woods of sunny Kent, I soon grew to love out-door life with a marvellous passion. The most serious blow I received was in 1875, when an odd copy of *The Entomologist's Monthly Magazine* came in my way. I spelt out its Latin with slow and laborious care, and read with wonder and horror those terrible descriptions of insects from some unknown regions with which it was filled. My heart sank within me, and was only lightened by the facts that it was a marvellous *Colias hyale* year, that I was in boisterous health, and born I veritably believed to do nothing but catch those charming Pale Clouded Yellow butterflies. At seventeen, we soon forget our first rebuff, and I soon forgot those Latin descriptions, for during the next five years I was hard at work. Among other things, I learned to read Latin with ease, and to understand, in a way, what Science was. About 1881, I first met my friend Mr. Coverdale. We were both essentially studious, as well as rabid collectors. He had gone in for a stiff course of scientific training, and I had done the same. We had been the only two students who passed in the higher stage of Animal Morphology and Physiology, at the South Kensington examinations of the previous May. We agreed to work together, and for a time did so; but a year or two afterwards he went abroad, and, after about nine months, passed into the great unknown, whence no word of him has ever reached us—his last letter expressing the anticipation that his wife was dying and that malarial fever had got its grip on him. From that time onwards, all I can say of my entomological work is—Is it not chronicled in *The Entomologist*, *The Entomologist's Record*, *The British Naturalist*, and even occasionally in that erstwhile dread *Entomologist's Monthly Magazine*?

I did not intend, gentlemen, to write an autobiography, but one's pleasures are written oft-times in one's self. And do not the inmost feelings of many of you respond to mine? Did not the exquisite pleasure of collecting, the charm of a country life, or the chance observation of one of Nature's beautiful productions first cause many of of you to collect? And if the exciting pleasures of youth have calmed down into the more tranquil pleasures of manhood, is not the same fulness of pleasure ours? The old feeling is engendered by the woods and trees. The exquisite sense of enjoyment recurs when we see the Purple Emperor fan his iridescent wings on the same branch of the old oak-tree on which we caught our first specimen. Do we not love our old haunts, our old nooks, our old friends? I love the old flowers, the old spots, and so I ween do all of us. If science grows out of

collecting so much the better, but, with the feelings we possess even the charm of collecting cannot be altogether in vain. Gentlemen, I hope I have not bored you with these personal reminiscences, I trust I have not disappointed you if you came in the expectation of hearing a learned peroration. I feel that science may, nay must, go largely to the winds for once, and that we will recapitulate our old experiences, fight our old battles, and enjoy the remembrances of the entomology of early youth, at least for a part of to-night.

But let us not forget, in the glowing reminiscences of our youthful experiences, that there is a deeper and more lasting passion in middle age for him who wishes to drink of it. The scientific enquirer leads a life which the multitude know not of. He has friends whom his most intimate acquaintances have never seen; occupation that leaves no time for lassitude or ennui; thoughts that carry him far away from the worries and cares of life. He leads, indeed, a double life, the peculiar part of this second existence being that no one who has not been admitted into the brotherhood of this supplementary life can understand its interest or its charm.

I have previously stated that I believe the best means of increasing the general interest in entomology, is for each and all who have the chance to point out the interesting side of the subject to those who show signs of taking an interest therein. But to leave the educational phase dealing rather with recruits, I would turn to that phase of it which affects the more advanced portion of the entomological community.

I have already pointed out that the systematic arrangement and naming of specimens was for many years the principal occupation of scientific entomology. But, side by side with these, there has always been an attempt to classify, as well as to name, the insects collected. As, however, until very recent years, the early stages of comparatively few insects were known (in many countries even now they are almost altogether unknown), it is evident that such attempts as were made (and in some countries are still being made) had to be based almost entirely on the colour, shape, form and general appearance of the perfect insects. What conclusions were drawn from these methods you all know. True it is that the conspicuous Sphinx larva; the peculiar method of progression of the Geometrid larva, and the leaf-rolling habit of the Tortrix larva gave the family names to at least three large groups; but at the same time almost all the references to old works make it only too sadly evident that the details of larval structure and their meanings were either unknown, or if known, were not looked upon as essential. As, however, the larger species became more and more intimately studied and certain characters became recognised as important, a new era of classification sprang up. This was instituted by Denis and Schiffermüller, and since then many have followed their lead.

It has, for a long time past, happened that the great mass of material collected has found its way into the hands of the authorities of our Museums, and hence a very large percentage of insects have been named by the entomologists attached thereto. It happens also, that, owing to the nature of such appointments, the persons selected for the work have usually had no special training. Prentice hands are therefore always at work on subjects requiring a skilled workman, and the

Museum apprentice rarely ever becomes a skilled workman, for his whole time is taken up in examining the dried bodies of insects, so that he has none to spare for the study of living insects. He may learn to name specimens; but when the naming *is* done, the real difficulties begin, for then the insects have to be classified, and how can this be done by a man with only a Museum training. The general characters of the imago have been all that such have ever had to go upon, and these alone, therefore, can by them be considered in deciding where any given species should be placed. Now such a method is at best but a poor makeshift, and must lead to a vast amount of error; and when the later philosophy began to gain ground, and it was shown that the general resemblance of many insects was due to outside forces and had no real meaning in so far as structural relationship was concerned—that colour as a character was unreliable because two specimens of the same insect might be, the one white, the other black; that the antennæ were untrustworthy because they varied in the sexes; that the marking varied endlessly in different individuals of the same species; that even the differences in leg structure, tufts of hairs, etc. were often but secondary sexual characters, in fact, that the real relationship between species was often obscured by dozens of matters of but little import in classification—then it became clear that a system of classification based on imaginal characters alone was necessarily a hotch-potch and not worthy of the name of science.

Our inability to prove some of the theories which have almost passed into axioms of belief, removes entomology from among the number of the exact sciences. We assume a special centre of creation for each species, and cannot conceive any other reasonable explanation; but yet, the fact, that such a fundamental point has not been proved, is fatal to the exactitude of the science we profess. Similar cases will occur to many of you. But if, in its philosophical aspect, entomology may not be considered an exact science, nevertheless, its philosophical bases are as sound as those of any other branch of biology, and in connection with the soundness of the biological facts, I will say my last word on classification.

The object of classification is, to place together those species which have most recently developed from the same stem, working back as far as may be through the most recent stems to those less recent, and so back to that from whence all have arisen.

At present we see but darkly. We ourselves hardly know what we want. We are like blind men groping for the light. We do not really know what are the essential characters in our insects which will enable us to trace back their origin, and hence we move in mist, and only emerge now and again from our confusion. But the physiologist and embryologist have come to our aid, and we find that certain broad axioms hold good through the various stages of development of all living things. Biological students have formulated certain generalisations, based on broad and comprehensive data, and these generalisations apply to all branches of animal life. The biologists tell us that the only system of classification which can be natural, must be based on those stages in which we may read the past history of the insects, so that the system of classification becomes, when thoroughly worked out, as it were a genealogical tree of the insects. The linear arrangement, they say, is evidently unsound to the most cursory observer. The embryological conditions,

i.e., all those which precede maturity, say they, are those which point out to us most strongly the changes through which animals have developed in the far past, and unless entomologists are to fall outside the line of biological advance, they must accept the dictum. But this entails enormous work. Where is the material on which such a classification can be built? We have not got the material yet, we have it to collect; we know that the work will be slow, but in such an important matter it is necessary to progress slowly. *Festina lente* must ever be the naturalist's motto. Then vested interests step in. Classification has always been considered the special perquisite of namers and describers of new species. The family and generic names (which represent in a large degree our classification) may want changing, and then the synonymy bogey steps in. What is the advance of science, compared with the erroneous use of a name? says the stickler. Are not names a part of the science, indeed are not names the science? asks bogey; and if we don't agree, the synonymy man says what fools we are. Our catalogue-makers and synonymy men, as a rule, know nothing of embryology or of the deeper parts of biology. The very nature of their labour prevents them from getting the necessary information, or making the necessary observations on the early stages, which would enable them to work out a system of classification on the new lines. They do not offer active resistance as a rule, but go steadily on in the old groove, perversely overlooking the overwhelming facts that should show them at once that they are nothing but obstructionists to science, that they are even belying their scientific existence and becoming propounders of error, preferring to live in darkness rather than in light.

But this passive resistance is not all. Occasionally one hears the wail from a conscience-smitten individual—"Well, we are biologists after all, are we not? Do we not study nervures, palpi, genitalia, wings, etc? How dare anyone say we are not the elect, that we are not fitted to continue as prophets to our generation? From such, one question only needs an answer: "What is biology?" They entirely overlook the fact that biologists are agreed that it is the embryological, the immature stages of the animals, which must give us their true history through time. So they go on, until at last there is almost open war between the closet naturalist who studies nothing but dried bodies, and the practical man who rears, observes and experiments on the living insects in all their stages. What the final end must be is evident. Truth must conquer prejudice. We shall look to the Museum men to name our insects, to the biologist to classify them. The superficial, one-sided, slip-shod work of half-a-century ago, will not do for the go-ahead scientific spirit of to-day. The truth must ultimately prevail, the foes of progress must be defeated.

I feel strongly on this matter. It is high time that someone took up a strong line thereon. So far as the imaginal characters confirm the biologist's work, well and good; so far as any individual, for his own personal glorification tries to supplant biological work with superficial imaginal characters, small mercy must be meted out to him. Entomologists, if they wish to be considered other than dilettanti scientists, must fall into line with the workers in other branches of biological science. The characters of half-a-century ago may or may not be of service; at any rate, they must be considered in the light of the progressive science we know to-day. Progress, as I have said, must necessarily be slow,

but the clogs which retard progress want gently but firmly removing to a region, where, if they can do no good, they can do no harm.

Gentlemen, if any word I have said to-night leads one of you to take a more serious view of the work in which we are engaged, I shall have been well repaid. The City of London Entomological Society is obtaining a name for scientific work, second to none in the kingdom. The fact that we are numerically weak, that our subscriptions are kept low on purpose to attract the humble worker, at the same time militates greatly against us, in attaining a position in which more work can be given to the entomological public. For what we are able to do at present, we are largely indebted to the generosity of our worthy President, under whose guidance the Society has reached a recognised position in the entomological world. You have been reminded to-night that the "Fauna List of the London District," which, two years ago, you authorised (with some enthusiasm) certain members of the Society to draw up, requires printing. I have no doubt that many entomologists outside our ranks would willingly subscribe if they knew that the list was ready, and that the obstacle to printing was mainly financial. However, I trust that all will aid the committee, who have the matter in hand, to the best of their ability, and that its publication will be persevered in. If it be, I am quite sure that it will bring you further renown, and gain you the further respect of the entomological world

And now, gentlemen, I leave you in the hands of our kind President, for another. I hope for many other years; under his genial rule, I do not doubt that the wheels of this Society will move with as little friction, and the work done be of the same high character, that has marked the preceding years.

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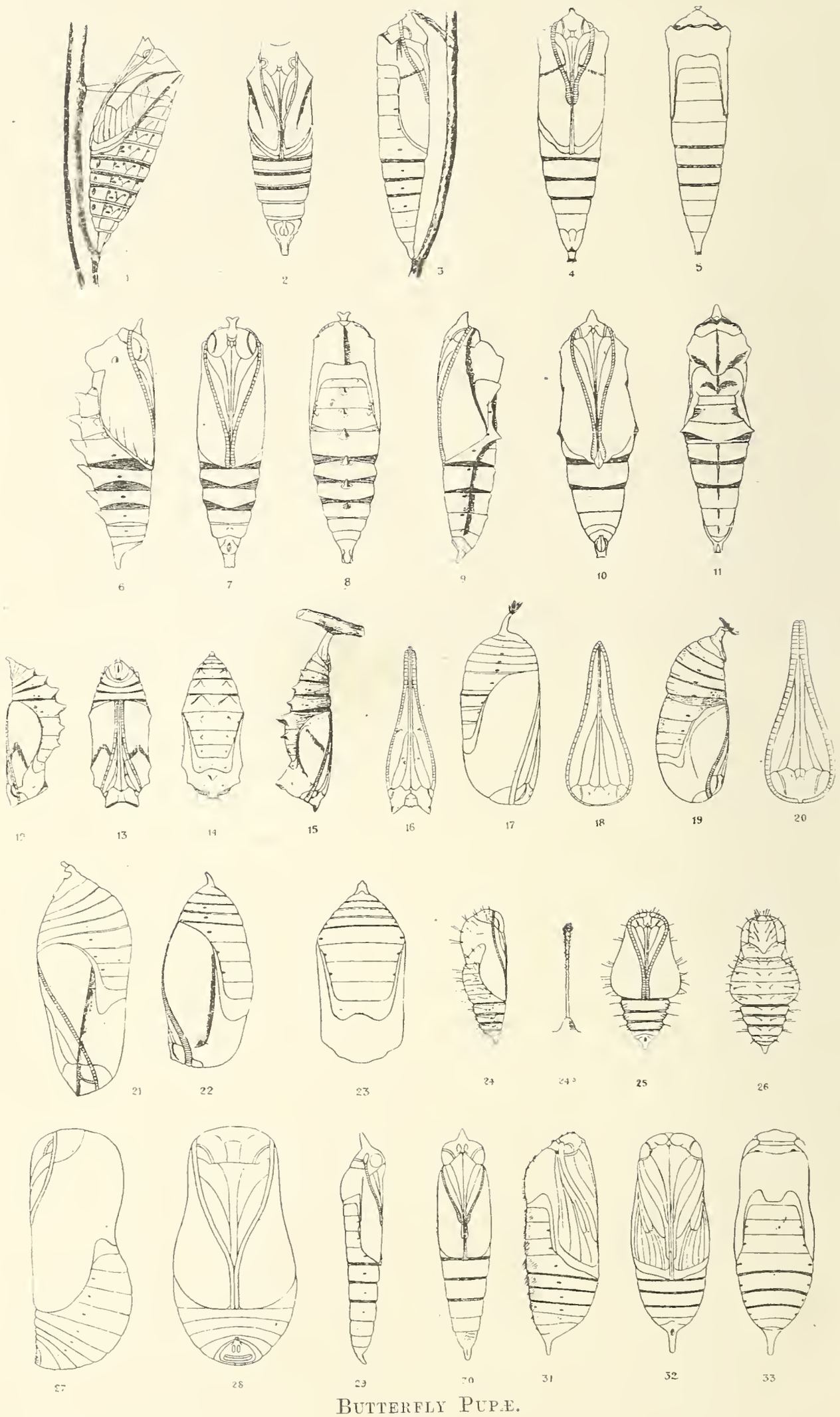

BUTTERFLY PUPÆ.

Notes on Butterfly Pupæ, with some remarks on the Phylogenesis of the Rhopalocera.

By T. A. CHAPMAN, M.D., F.E.S.

The object of this paper is to furnish an analysis of certain details in the structure of the pupæ of the RHOPALOCERA. These details have been found to be very interesting in the case of the HETEROCERA, where they appear to give indications of the lines of evolution of the different groups and families at least as plainly as any other details of structure that have been studied with a view to tracing these relationships, and in the main to point to phylogenetic arrangements very similar to those which have been elucidated in other ways by various authorities, and so to lend valuable support to the change which has been made in the position of some of the families.

I may say that, with the butterfly at least as much as with the moth, I have found it necessary actually to handle the pupa, or pupa-case, in order to understand it, as hardly any description or figure gives the requisite information. It is true that from a figure, the pupa of, say, *Callidryas* (an American genus between *Colias* and *Gonepteryx*) can be seen to present a similar form and structure to that of *Colias* or *Gonepteryx*; but one is, so far as the figure goes, left quite in the dark as to precisely what that form and structure are, and can only judge thereof by one's knowledge of the pupa of *Colias* or *Gonepteryx*, or some similar pupa. But in any family of which one has not actually handled a pupa, a figure or description is generally of very little use. Further, a great many descriptions deal only with general form and coloration, and not with minute structure.

I must here express my indebtedness to Scudder's *Butterflies of New England* for much information on the morphology and classification of butterflies. The classification which he adopts is a modification of that first proposed by Bates, and is one which my observation of pupæ confirms, not only broadly but in considerable detail. This fact gives me great confidence that the view which I take of the value of certain points in pupal structure must be largely correct.

In Scudder's book much light is thrown upon almost every point relating to butterflies, and it is unquestionably the profoundest and most able work yet published on this section of the Lepidoptera. Yet it is remarkable that throughout his classification, where founded on pupal characteristics, as well as in his descriptions of individual pupæ (with the exception of a vague reference under *Hesperidae*), there is no allusion whatever to the question of free segments, no statement as to which incisions still retain power of movement in individual species, no mention of the remarkable limitations of this movement in Pierids and Nymphalids, and reference is made to one only of the "Micro" characters preserved in the *Hesperidae*, and then without any apparent recognition of its significance. At least I have failed, after close study of the book, to find more than this, and could hardly have overlooked such allusions did they exist. I mention this in order to illustrate the defectiveness of descriptions and figures generally. If in a work of the highest class, such as Scudder's undoubtedly is, so little assistance is afforded in some important directions, it is obvious that in less

Read April 17th, 1894.

scientific works still less help is to be looked for; it also seems to point to the fact that the lines of evolution followed by the lepidopterous pupa have not only been unnoticed but, one might suppose, have hardly been regarded as existing.

It follows from this, that the material on which this paper is based —*viz.*, such butterfly pupæ as I have myself been able to examine—is extremely meagre, not amounting to more than 2 or 3 per cent. of the ten thousand and odd species of butterflies that exist; again, while it has been abundant in some families, there are other families of which I remain entirely ignorant. The material at my disposal is, however, sufficient to bring out some important points very distinctly, but others are still obscure and untouched. It is necessary for me, therefore, to say emphatically at this point that where I make any statement broadly or dogmatically, I do so always with the proviso understood (but which it would be wearisome continually to repeat), that such statement is correct only so far as my observations have extended.

To lay this paper before you with such a narrow basis for its foundation, may perhaps require an apology; if so, the apology would be, that valuable conclusions may be reached even from this narrow basis, and that the basis is not likely to be materially widened at any early date unless attention is called to the subject by some such paper as the present.

I shall refer to various characters of the pupæ and, in support of the conclusions to which these appear to point, to a few matters outside pupal structure; but I desire to direct attention chiefly to the progress which is evident in the pupæ of the Rhopalocera, as in those of Heterocera, from a condition of greater to one of less freedom of movement of the segments; to the progress from a greater number of exposed appendages (a decided "Micro" character) to a less number, though this is not illustrated amongst butterflies except, perhaps, as between Hesperids and Papilionids; and to a general progress towards a smoothly rounded, solid form, which, however, is greatly interfered with amongst the butterflies by the exigencies of the development of protective resemblances.

I am not aware of any instance in which a pupa appears to have been derived from an ancestor which possessed a less number of movable parts and, provisionally, I take it, as a rule, that MOVEMENT IS NEVER REGAINED BY A PUPA WHEN IT HAS ONCE BEEN LOST. That this should be so, is by no means self-evident but, as a matter of observation, it appears to be the case.

In the course of my study of pupæ and of some other matters in connection with Lepidoptera, the conclusion has forced itself upon me, that a circumstance in the progress of evolution which I had believed to be rather rare is really very common. This is, that similar structural characters (sometimes one might almost say identity of structural characters) have been reached along different lines by descendants from a common ancestor, who did not present any indication of them.

One of the most notable instances of this is to be found in the form of pupa which I have described (*Trans. Ent. Soc. Lon.*, 1893, p. 97) as characteristic of the Macro-Heterocera; that is, a pupa in which the first four abdominal segments form part of the thoracic mass, the 5th and 6th being free to move on their neighbours, whilst the 7th, 8th, 9th and 10th form another solid piece. One might look upon this

arrangement as one, the attainment of which was regarded (if we may use such language) as an object of ambition by the earliest Lepidoptera, which as yet possessed freedom of movement of a majority of their abdominal segments, and in which the 7th was still movable in the male although not in the female pupa. Setting off along several different roads, the structural arrangement mentioned above has been arrived at more especially by the MACRO-HETEROCERA. Whether it has been reached by one or more routes I am not at all certain, but I am disposed to think that amongst the BOMBYCES will be found groups that have attained this condition of development independently of one another; I am not at all sure that the PYRALIDES do not represent a separate line; but, at any rate, it seems certain that the butterflies have taken an entirely independent route.

Like the pupa of the MACRO-HETEROCERA, that of *Papilio* (Figs. 1, 2) has got rid of nearly all "Micro" features; there is no dorsal head-piece; there are no maxillary palpi; the antennæ separate from the head-piece on dehiscence (*i.e.*, when the imago emerges); only the 5th and 6th segments are free, and these possess the power of movement in all directions. There are, however, two earlier features retained by the Papilionids which the MACRO-HETEROCERA have lost; one of these is the possession of a waist, caused by the narrowing, chiefly by dorsal depression, of the last thoracic and 1st and 2nd abdominal segments; the other is a certain amount of opening, on dehiscence, of otherwise solidified incisions, which is observed in some species. There is another noticeable difference which may possibly be associated with the retention of these early features; the Papilionid pupa is capable of further evolution, as evidenced by the fact that additional features appear as we pass from it to the higher families, whilst the "Macro" pupa among the HETEROCERA seems to be a terminus not yet at least over-passed (*Spilosoma* may seem to be an exception).

Ephyra Zonosoma is interesting as an illustration of the fact that habits and structure very nearly identical may be reached by quite distinct paths. Just as the pupa of *Papilio* is, in its general structure, nearly identical with that of one of the MACRO-HETEROCERA, so that of *Ephyra* comes even closer still to that of *Papilio*, with which it is nearly identical in general form and in manner of suspension. Yet it is as nearly certain as anything of the sort can be, that we must go back as far, or nearly as far, as *Hepialus* to find a common ancestor. Wherein then does the pupa of *Ephyra* differ from that of *Papilio*? It is smooth and rounded; still it has a well-developed ridge near the inner margin of the wing similar to that in *Papilio*, and this is very unusual in a Geometer pupa. This ridge originates at an anterior spine that, in *Papilio*, usually gives off a ridge to the middle of the wing, the inner marginal ridge starting from a spine situated farther back. Yet there are pupæ of *Papilio* in which there is little or no trace of the ridge running to the centre of the wing, and in which the two spines are connected by a ridge; whilst in *Ephyra* there is a slight break, as if a posterior spine could be distinguished. But there are points of difference between the pupæ which seem to be quite distinctive; the first of these is the entire absence in *Ephyra* of any nose-horn; a second, that the girth is not incorporated in the pupal case across the dorsum; thirdly, in *Ephyra* a portion of the femur is seen between the maxillæ and the first pair of legs, whilst between the apices of the wings the tips of the antennæ, together with the ex-

tremities of two pair of legs, are visible. It is certainly very rare for even one pair of legs to reach this point in *Papilio*, and I know no instance of an exposed femur therein. In some Hesperids the girth is loose and the tips of the third pair of legs are exposed beside the wing apices, a feature that does not occur in true butterflies. The fourth difference between the pupæ of *Ephyra* and *Papilio* lies in the frequent opening of closed incisions on dehiscence in *Papilio*; this does not occur in *Ephyra*.

In taking *Papilio* as the simplest form of the true butterflies, and therefore as nearest to the Hesperids, and in regarding the other families as derivatives from *Papilio*, I desire to be understood merely as meaning that *Papilio* still closely represents the primeval butterfly when it had become truly a butterfly as distinguished from a Hesperid, and as regarding the other families as having been derived from this primeval form, and not from *Papilio* itself. The pupa of this primeval form possibly differed from that of *Papilio* in having a single instead of a double "nose-horn," but no doubt *Papilio* very closely resembles it.

I may mention here that Scudder gives the names "ocellar tubercle" and "ocellar prominence," to what I have called "nose-horn." I have preferred the latter as a provisional colloquial name, because it involves no theory. The term "tubercle" is now so definitely appropriated (in Lepidoptera) to certain larval structures, that one does not choose to use it in the case of pupæ, unless one wishes to suggest that the pupal tubercle represents the larval tubercle, as is certainly the case in some pupæ of Tineina and others, where their disposition and possession of hairs is identical in larva and pupa. In the butterflies, the "ocellar tubercle" is, more probably than the reverse, not identical with a larval tubercle. As to "ocellar"—the position is in front of the eyes, and it no doubt serves for the protection of the eyes, as well as of the rest of the head; perhaps even more for the protection of the bases of the antennæ than of the eyes. But, assuming an ocellar site for the nose-horns of *Papilio*, is it certain that the nose-horn of *Pieris* is the same structure, conjoined in the middle line? In many pupæ there may be seen, between the double nose-horns, two minute prominences, which are possibly those that are developed in the *Pieridae*. These may be seen in most Vanessids, and, in such a pupa as *Doritis*, where the nose-horns are so short that their existence might be disputed, there are between them, two very distinct tubercular eminences. The front of a butterfly pupa has, in fact, an inner and an outer pair of eminences. Is it certain that the inner pair does not form the "nose-horn" in some cases? If it does, it would not properly be termed "ocellar." It is perhaps of more importance to note that the eyes are dorsal structures, whilst the nose-spines are ventral.

From this original form the other families branched off. 1. *Parnassiinae*; this did not progress very far beyond *Papilio*, and is sometimes included in the *Papilioninae*. 2. *Pieridae*; and along with them *Nymphalidae*, the latter leaving the *Pieridae*, whilst only the earliest forms of the latter had been evolved. 3. *Lycaenida*.

In each of these groups, the lowest forms agree with the primeval butterfly in the movability of the 5th and 6th abdominal segments, but, whilst the others progressed, more or less rapidly, to forms with com-

plete immobility of those segments, *Papilioninae* stands alone, constituting an apparently separate family that made no further progress in this direction.

The first of these lines of development, the Parnassian, seems the simplest; an early result is *Thais* (figs. 3–5), which has a truly Papilionid pupa, but one with certain peculiar features which it will be more instructive to return to, when we come to consider the origin of *Nymphalidae*.

In the second line of development, the Pierid, we find a change which does not occur, so far as I know, in the pupa of any of the Heterocera. By the development of certain dorsal tubercles at the margins of the segments, (possibly due to the fusion of the anterior trapezoidal tubercles of the larva), antero-posterior movement is lost, only lateral movement is possible; so that whilst a Papilionid pupa can move its tail in any direction, that of a Pierid (figs. 6–11) can only do so from side to side. The peculiar method of suspension adopted by the Papilionid pupa, restricts antero-posterior movement, perhaps even renders it dangerous; accordingly, even in *Papilio*, this is less free than lateral movement, and we can understand how easily it might be lost, and the Pierid form originated. In the Pierids there is also a change in the egg; the hemispherical, smooth form gives place to a taller, ribbed structure.

Among the *Pieridae* further changes in the pupa occur, resulting in a further loss of motility of segments; in *Pieris* (figs. 9–10–11), and in the *Rhodocerinae*, we find only the 5th segment movable, whilst in *Euchloë* the pupa is solid and immovable.

There is, I think, something to be said from a larval, and even from an imaginal point of view, in favour of the notion suggested by the pupæ, that there is at least as great a gap between *Aporia* and *Pieris*, as between the latter and the *Rhodocerinae*.

The third line of development from the primeval, Papilio-like form, is in the direction of the Lycænids. Here my material is so scanty that I have found very little trace of intermediate forms. There is, however, I think, much to be said for the possibility of the Lycænids having been derived from the Hesperids, merely grazing, as it were, the Papilionids on the way.

The Lycænids at least acquired the same method of pupal suspension as the Papilionids; and further, they lost the "Micro" habit of the Hesperids of hybernating as larvæ, and acquired the habit of doing so in the egg or pupa-stage; the egg, likewise, is much farther from a Hesperid egg than is that of a Papilionid. *Parnassius*, at first a very puzzling form, comes in here to give us some little assistance. Its pupa is very much like that of the Lycænids, from which it differs chiefly in lying free in a cocoon, instead of being suspended by a girth; this condition is, however, attained by not a few Lycænids. The egg possesses certain Lycænid features, in particular the depression at the top around the micropyle; hybernation also takes place in the egg-stage, a circumstance very rare in butterflies, except amongst the Lycænids; but I have ascertained that in *Parnassius* the young larva is developed in the autumn, and passes the winter coiled up within the egg-shell.

The Parnassids are a small family and, so far as we know, did not develop such a variety of forms as the parallel Lycænids. Partly, probably, for this reason, and partly because *Thais*, although apparently

a Parnassid, is more nearly a Papilionid they have usually been left among the *Papilioninae*. The few forms we have, however, to judge from the pupæ which I have been able to examine, are in reality rather widely separated from each other, and suggest that they are only the remains of a much larger family, of which the intermediate forms have been lost. A few words upon the several forms may therefore be interesting.

1. *Thais* (figs. 3–4–5).—Here the head spines of *Papilio* are either lost or modified into the double central knob which carries the hooks. The front of the pupa is curiously flattened and hollowed, by the falling in of the pro-thorax and front of the meso-thorax. It is to be noted, either as showing that *Thais* is rather a Papilionid than a Parnassid, or as showing the line of Parnassid evolution, that a genus usually left with *Papilio*, containing some half-dozen species, of which *dissimilis* is perhaps the best known, has a very similar form to *Thais*, though its suspension is of the orthodox Papilionid type.

2. *Sericinus*.—Here the form and structure are very similar to *Thais*; but, while the cremastral hooks are lost, the double nose-horns of *Papilio* are retained; both the 5th and 6th abdominal segments are still free; and the dorsal spines of *Papilio*, duplicated on 5, 6 and 9, are present; the egg is quite Papilionid.

3. *Luehdorfia*.—In this, we still find suspension in Papilionid-fashion, and the pro-thoracic spiracles have the same pit-like aspect as in *Thais* and *Sericinus*, but the general form is now squat (like that of *Parnassius*) the surface rough as in *Doritis*, and there is movement only at the 4th abdominal incision; the nose-horns are still quite distinct.

4. *Doritis*.—This much resembles *Luehdorfia* in form and appearance, but has lost the cremastral hooks, as well as all power of movement; the pit of the pro-thoracic spiracle still appears, but is much less pronounced, whilst the nose-horns are reduced to obsolescence. The egg is dome-shaped as in *Papilio*.

5. *Parnassius*.—This is nearly identical with *Doritis*, except that the rough surface is replaced by a very smooth one, which is covered by a resinous bloom; this gives it an extremely different aspect, and is associated, no doubt, with the habit of making a strong, though loose cocoon, often in moist situations. The ventral position of the head indicates the thoracic pitting otherwise smoothed out.

All these forms are evidently related, but they do not admit of being arranged in a linear series. The earlier forms, at least, possess the intersegmental sub-segment, whilst the head gradually assumes an inferior position, almost as pronounced as in the Lycænids.

The Nymphalids agree with the Pierids in two very important points; the egg is ribbed, and the pupa possesses only lateral motion —all antero-posterior movement having been lost, although, from its manner of suspension, free movement in all directions would have been of advantage to it. Since the loss of this movement must have resulted from suspension by a girth, it seems certain that the Nymphalid coul not have acquired it independently. It forms a remarkable illustration of the law, that movement once lost is never regained.

If we imagine a Pierid pupa to have got rid of the girth and to hang by the tail, we have substantially a Nymphalid pupa, the duplication of the head-spines and some other changes being of a minor character.

A Nymphalid, then, is a Pierid that has got rid of the girth; and here it is of much interest to note that the Papilionid made an effort in the same direction, but only succeeded in traversing a short part of the distance, evolving the remarkable form we find in *Thais*.

The account given of the method of suspension of the pupa of *Thais* in Scudder's monumental work is only at second-hand, and appears to me to be erroneous. The existence of a double set of hooks on the head-prominence of this pupa is so unusual and extraordinary a phenomenon, that one accepted without hesitation Scudder's statement that this is entangled in a special silken pad. Subsequently, however, the examination of a consignment of pupæ of *Thais* led me to entertain great doubts as to its accuracy, and to think that the nose-hooks and their use, extraordinary as they still are, might yet be so explained as to permit the ranging of the pupal structures and habit with those of the Papilionids, and might enable us to understand how their development was brought about.

According to the account given in Scudder's work, the pupa has three points of attachment—a pad for the tail, a girth for the body, and a pad for the nose. Now we know that in *Papilio*, *Pieris*, etc., there are only two—one for the tail, and the girth—whilst the line of evolution is in the direction of a loss of the girth, and thus of a diminution of the number of points of attachment (Nymphalids). These two points themselves are, no doubt, the result of a gradual modification of the cocoon of the Hesperids; it seems to me, therefore, most improbable that a third point of attachment should be evolved.

An examination of the pupæ referred to, shows that the nose-silk is not a new structure but is the girth slipped forwards; also that the slipping forward does not occur, in many cases at all events, until the girth has had time to impress its marking across the wing-covers. It must occur whilst the pupa is still soft and capable of some activity, but I have not seen how it is accomplished. The peculiar curved attitude of the larvæ of *Euchloë* and *Colias*, after suspension but before pupation, may afford a hint as to how the shift originated. When the girth did so slip forwards, one of two things would happen; either the pupa would swing free, thus leading to the Nymphalid type; or the girth might catch on the projecting nose-horn, and in time lead to the structure and habit that characterise *Thais*. I may note that the pupa of *Thais* has both the 5th and 6th abdominal segments free and with power of movement in all directions; so far, therefore, it is clearly a Papilionid rather than a Parnassid or a Pierid. The nose-thread is a loop, exactly such as the girth slipped forwards would be; it passes forwards from its points of origin to the nose, whilst there is a groove marked on the wing-covers, that is exactly in a line from the same points of origin, backwards (fig. 3). A close examination of a number of specimens shows no trace of any other girth than this nose-loop, either on the pupa itself or in the form of any attachment to the silk pad, which is smooth and finished throughout, and clearly has not had any other loop torn from it or removed. That the pupa is tolerably active when the slipping forward takes place is evidenced by the nose having twisted itself into a second loop of the girth round the hooks in many instances.

Thais, however, did not lose the girth entirely and so become a suspended pupa like the Nymphalids. It is, as we have seen, one of several forms, that do not lead directly to *Parnassius* in lineal order, but appear to have branched off from the Papilionids at the same time. In the Pierid we have a Papilionid that has lost the power of lateral movement, probably in connection with the method of suspension by a girth. The Nymphalid is a Pierid that has lost the girth. This close connection of the Pierids and Nymphalids is one that has not apparently been hitherto insisted on. The form of the egg is the same in both, and differs from that of the Papilionids, which retains the smooth dome-shaped form characteristic of the egg of the Hesperids. Again, the restriction of movement to the lateral direction is very remarkable, for it occurs nowhere else; and, since it exists throughout both these nearly related families, it seems reasonable to assume that it is a common inheritance and not a separate acquisition, especially as it is obviously useful to the Pierid but of no obvious value to the Nymphalid, in which it persists only because movement once lost is never regained (at least this rule holds so generally true, that we may reasonably apply it here in explanation.) But, accepting this explanation, it follows, that the divergence must have taken place whilst the Pierids still retained both the 5th and 6th abdominal as movable segments, as is still the case in *Aporia*, *Delias* (figs. 6-7-8) etc.; and further, seeing that the Nymphalid preserves the double nose-horn of the Papilionid it must have taken place before the Pierid was reduced to a single median one, and it is interesting to note that *Delias*, one of the earliest Pierids, still affords some evidence of the former presence of a double nose-horn in the Pierids. Our own *A. cratægi* does so in a less degree.

A consideration of these pupal characteristics, as well as of those of the eggs, leads me to believe that Pierid and Nymphalid started together from the Papilionid, shortly afterwards separating, and thence-forward pursuing very parallel courses. It would follow that, in spite of the method of suspension of the pupa and of sundry imaginal characters, the Pierids are nearly if not quite as much entitled as the Nymphalids to rank as a separate family from the Papilionids, and to be associated with the Nymphalids rather than with the Papilionids.

As we pass from the *Aporinae* to the higher sub-families of *Pieridae*, we find progressive loss of movement. In the *Pierinae* only the fifth segment remains movable; the same condition obtains in the *Rhodocerinae*, and in the *Anthocarinae* the pupa is solid. I have not obtained any Pierid pupa with only one incision moveable. Whilst I would separate *Aporia* from *Pieris* as distinctly as I would *Rhodocera* from *Anthocaris* (*Euchloë*), it seems incorrect to associate *Pieris* with *Rhodocera* because both happen to have the same formula of segmental mobility. The curved form of pupa, due to the ventral bulging of the wings and the shortness of the antennæ, associates *Rhodocera* and *Anthocaris*, but places them apart from the others. By analogy with other families, I should expect to find the Anthocarine pupa separated from the Pierine, whilst both were still at the Aporine stage, that is with both 5th and 6th abdominal segments movable, and that the genealogical tree would not be thus—1, *Aporia*; 2, *Pieris*; 3, *Rhodocera*; 4, *Anthocaris*, but rather as under, the blanks representing forms that probably exist though unknown to me.

	Early form with 5 and 6 movable.	
	Pupa straight.	Pupa curved.
3 incisions (2 segments) with movement	*Aporinae*	?
2 „ (1 segment) „ „	*Pierinae*	*Rhodocerinae*
1 „ „ „	?	?
0 „ „ „	?	*Anthocarinae*

In the Nymphalids we again find that movement of segments is lost in some tribes. If we assume those with full movement to be the lowest (that is the least divergent from the ancestral form), then we must give this place to the *Vanessidi* (figs. 12–13–14–15), *Argynnidi* (including *Melitaea*), *Acraeidi*, *Heliconidi* and *Apaturidi*. Of these the *Argynnidi* would be the highest, as they have lost the straight form that would result from their derivation from the Pierids. Whether we may attach any value to the very Pierid-like aspect of sundry *Acraea* pupæ as showing them to be the lowest, is more than I am prepared to assert. The *Satyrinae* (usually so-called) would be entitled to be divided into several tribes, the lowest (the Meadow Browns) with freedom of movement preserved, being a tribe some steps in advance of the *Argynnidi*.

One chief reason for looking upon them as near the *Argynnidi* is the pattern of the pupal markings, which is very much the same as in *Argynnis* and *Vanessa*. The remainder form two or more tribes according to the loss of movement to one incision (*hyperanthus*) (figs. 22–23), or absolutely (*semele*, *galatea*). Though contrary to our traditions to place *galatea* as far away from *ianira* as *Vanessa* is from *Argynnis*, it is not so shocking on a little consideration as at first sight it appears. The pupa of *Vanessa* has very much the general aspect of that of *Papilio*, but differs in its method of suspension and in the suppression of antero-posterior movement. The *Nymphalidi* and *Apaturidi* have gone beyond *Vanessa* in developing various remarkable forms, but they retain the same degree of segmental mobility. When we come to purely exotic sub-families I am sorry that my material is so small. The *Euploeinae* (fig. 17) develop a remarkable ridge across the third abdominal segment and lose freedom of movement altogether, thus giving rise to remarkable forms as, for instance, in the genus *Euthalia*, where this ridge and others are developed in an extreme degree, forming sharp angles and making the pupa not unlike, among pupæ, what the larva of *Hybocampa milhauseri* is amongst larvae. In some instances of which I have seen specimens and drawings there is apparently a mimicking of some, no doubt unsavoury, Hemipteron, the pupa being fully exposed on a leaf.

Charaxes (fig. 21) is very close to the *Euploeinae*, and has no near relationship to the *Apaturidi* or *Nymphalidi* (White Admirals), which is awkward, as *Nymphalis* is a generic name often used instead of *Charaxes*. *Charaxes* has a very smooth rounded pupa, without movement, and very like that of *Euploea*, deprived of its ridges and angles.

In the *Brassolinae* (figs. 19–20) an even more remarkable condition occurs. There appears to be no movement of any segment; but the intersegmental membrane of the hinder margin of the fourth abdominal segment is much expanded, and forms a portion of the solid surface of the pupa equal to about two-fifths of the whole segment;

it looks, indeed, like a separate segment, especially on the ventral surface, where the wing-margins reach to the true margins of the segment but leave the additional portion uncovered. On the dorsal line it is constricted, showing the arrangement characteristic of Nymphalids for checking all but lateral movements, though, as a matter of fact, no movement at all exists in this case. This incision seems to open slightly, in some species, on dehiscence. A similar but less obvious exposure of intersegmental membrane occurs along the hind margins of the four following segments. Remarkable as this structure is in this group, and associated as it is with complete loss of movement, it is to be noted that the same advancement of intersegmental membrane to a permanent and fixed surface position is quite plain, when looked for, even in *Vanessa* and still more in *Pyrameis*; in fact it is, as a constant but not always prominent structural detail, a feature of all butterfly pupae except those of the Lycænids (and Hesperids) (figs. 1–2 *Papilio*). In the Pierids the marginal portion sometimes looks more like a distinct subsegment than like a portion of elaborated intersegmental membrane, and I am certainly not prepared to be dogmatic as to its true nature. It comes, however, as a strong support to the idea that the Lycænids separated from the primitive Papilionid as soon as (or almost before) the latter had evolved from the Hesperids.

Some species among the Brassolids (*Dynastor*, for example) have the wing-cases expanded laterally like some Papilionids.

When we come to the Lycænids, we find that the pupæ best known to us agree with those of the Papilionids in their mode of suspension, but in little else. They differ in being entirely solid, very rounded, and squat; in having the head curled under so as to be ventral rather than anterior in position; in not possessing the intersegmental subsegment; and in having no definite spines, horns, or processes, but in possessing hairs and bristles. The *Lycaenidae* are usually divided into *Lycaeninae* and *Lemoniinae*: I am inclined, however, to think that we should substitute the name Lycaenida for *Lycaenidae* and constitute two families *Lycaenidae* and *Lemoniidae*. The latter should then be divided into sub-families. The mass of the *Lemoniidae*, in a character to be presently alluded to, are higher than the *Lycaenidae;* and yet it is amongst the former sub-family (as at present constituted) that we must look to find the forms nearest to the primeval, that is, forms with both the 5th and 6th abdominal segments movable. Some approach to this form I happen to have seen in *Euselasia* from South America (figs. 24–25–26). There we have a pupa unmistakeably Lycaenid in the ventral position of the head, in the squat broad outline, and in the hair-like character of the spines, which latter, however, exist only on the ordinary tubercles and not, as in the *Lycaenidae*, on the general surface also. The second legs reach the eyes as in the *Lemoniidae*, but both the 5th and 6th abdominal segments preserve movement. By this latter feature, as well as by the spinous nature of the hairs, the pupa shows a much nearer approach to the primary Papilionid form than does the solid pupa of the *Lycaenidae* (figs. 27–28). There is no trace of a marginal intersegmental subsegment.

In the *Lemoniidae*, if we only had the material (apparently abundant enough in S. America), we might expect to find at least

certain stages of the progress from the primeval butterfly to *Euselasia* and certainly forms intermediate between the latter and the *Nemeobiidi*, which in solidity, hairs, and general form differs little from Lycænines.

The *Lycaenidae* apparently made a short cut to a high form. This is to be taken less as my view of the facts, than as an expression of my ignorance of any of the possibly still, but no doubt once, existing intermediate forms with mobility of segments. The pupæ of all the genera are very close together, very rounded and solid, but preserve the Papilionid arrangement of the leg-cases; the *Lemoniidae*, so far as the few which I have examined go, have attained the Nymphalid arrangement. This point in the structure of butterfly pupæ, which seems to be of some importance, is one upon which I am sorry to say that I have only a few notes of pupæ that I have examined but not possessed, so that I speak here from a smaller basis even than elsewhere. In all butterflies (including some Hesperids) the area between the head and antennae is occupied by the maxillæ (proboscis) and the 1st and 2nd pairs of legs, and by these only. The point to which I wish to call attention, is as to the relative position of the two pairs of legs. In the Papilionids and Pierids the 1st leg at its base extends from the maxilla on the inner side to the antenna on the outer, and so cuts off the 2nd leg from approaching the head (figs. 2–4). In the Nymphalids the 2nd leg extends upwards and reaches the eyes (head), and so cuts off the 1st from reaching the antennæ (figs. 13, 16, 18, 20). We may here frame a pretty little hypothesis that this is the natural result of the atrophy of the 1st pair of legs in the Nymphalid imago; and that this is no doubt an element in the case, is confirmed when we notice how small the 1st pair of legs becomes in some Satyrids—*hyperanthus* (fig. 22), for example. But when we extend our survey, we find that the reduced size of the fore-leg obtains in the Hesperids (figs. 29–33) from which the Papilionids are supposed to have had their origin, and when we come to the Lycænids, we find the reduced size in the *Lemoniidae* (fig. 25), which possess forms nearest to (but also probably more recent than) the Papilionids, whilst in the *Lycaenidae* (fig, 28), where we might also look for a Nymphalid type in this matter, the fore-leg reaches the wing as in the Papilionids, as it does also in Parnassids. This would point to the commencing atrophy of the fore-legs of the imago in the Lycænids as occurring quite independently of the same process in the Nymphalids. Another illustration is thus afforded of a condition of things of which I have already spoken as by no means rare in the Lepidoptera—*viz.*, of similar stuctural developments taking place independently in different families, the common inheritance being, not the structure itself, but a tendency, or at least a capacity to develop it.

There is at least one other distinction between Lycænid and Papilionid pupæ which is strongly suggestive of their separate origin. The Papilionid and its derivatives, the Pierid and Nymphalid, always have smooth pupæ, that is pupæ which have no bristles or hairs; their spines and processes are developments of the pupa itself, and cannot be injured without opening the general body cavity. Lycænid pupæ on the contrary, have hairs and bristles, that is, cutaneous appendages that can be removed without any substantial damage to the pupa proper. Both these forms occur among the Hesperids.

In the White Admirals (*Nymphalidi*) a few hairs are to be distinguished in the pupa, but they are so minute as to require some magnifying in order to be seen. Perchance a similar close search might reveal them in other tribes. It is curious that it is in this same tribe that the only trace among the Nymphalids of any resemblance in the egg to that of the Lycænids occurs. The White Admirals, no doubt, are really one of the lower tribes of the *Nymphalinae*; they still retain 5 and 6 free and are still especially capable of great variation in general form as well as in their spines and processes; these Lycænid features appear to give a farther confirmation to one of the points which I desire to emphasise, *viz.*:—that the lowest (*i.e.*, most ancestral) forms in all the families are really very close together, and that it is only in the higher tribes that the families are widely separated.

In thus postulating a separate origin for the Lycænids, I think I clear up the great difficulty that has troubled systematists who have desired a linear arrangement, and who have believed from the condition of the fore-legs of the imago, that the Lycænids should occupy a position intermediate between the Papilionids and the Nymphalids, a position absolutely contradicted by egg, larva and pupa, and, I think, quite as much by the general facies and structure of the imago.

The *Lycaenidae* appear to be farther from the Papilionids than the mass of the *Lemoniidae*, but I think from the pupæ I have seen, that the latter are divisible into several sub-families, each of equal value to the *Lycaeninae*, and some of which are farther from the Papilionids than they are.

Scudder notes that, among other things, the primeval butterfly hybernated as a pupa. If this be true, then the line separating butterflies from moths must be drawn between the Papilionids and the Hesperids; for only a few, and those of the higher, *Hesperidae*, hibernate as pupæ; the Papilionids and all above them are butterflies, the rest are moths. It is, perhaps, well to assert this in this dogmatic fashion, as it affords an opportunity of referring to the many moth-characters present in the Skippers—characters not of the Macro-Heterocera, but of the "Micros." Of course, the whole matter is only one of words. Butterflies, at and above the Papilionids, are butterflies; *Sesia*, *Cossus* and *Hepialus*, are moths; the Skippers are intermediate, but are so much closer to the butterflies, that it is more correct to call them butterflies than moths. Still, one may choose to draw the line above them; but whoever does so, does not alter the fact, that on the one hand they are much closer to butterflies than are any unquestionable moths, and on the other hand that they possess micro moth-characters that butterflies have no trace of.

Of these, perhaps the most remarkable affect the larval prolegs. In true butterflies, these have the same structure as in the Macro-Heterocera, although no doubt this has been quite independently acquired. The row of hooks exists only along the inner margin of the originally circular pad, and its derivation from a complete circle or crown of hooks is much more frequently recorded here, by means of its persistence in the earlier stages of larval growth, than is the case among the Macro-Heterocera. In the Skippers, the circle of hooks usually remains in the adult larvæ as in the Micro-Heterocera. In a few species (*C. palaemon* for example) there is a simple circle, or rather an oval, with

a gap at the inner side, a condition almost identical with that found in *Sesia*; but in many of the species (or chiefly among the *Pamphilidi*?) there is a complete circle, repeated in three rows, the outer row having the smallest hooks; this latter form is met with elsewhere only in *Hepialus*, and is, therefore, a very archaic form of pro-leg.

In the pupa there is one "Micro" character to which I find that Scudder calls attention, though he does not appear to be aware of its significance—the persistence of the dorsal head-plate (cephalo-thoracic piece). In addition to this feature, the pupa presents several others that point to its still strong affinities with the MICRO-HETEROCERA. I have only possessed a few Hesperid pupæ, and those which I have examined from other collections had of course to be respected, so that I am still in some doubt upon some of the points connected therewith.

I think it is the case, that the species belonging to Scudder's tribe *Pamphilidi*, which includes our *sylvanus*, *linea*, &c., possess in a more marked degree the features of the Micros than do those belonging to his *Hesperidi*. I will, however, only say that some, and I think probably a majority of, species present most of the "Micro" characters which I am about to enumerate. I need merely refer to such well-known characters as the making of a cocoon, and hybernation as a full or nearly full-grown larva; both of these are distinctly moth characters, and the latter is a "Micro" habit and does not, I think, occur in any true butterfly. The possession by the pupa of a dorsal head-plate, as noted by Scudder, is also a "Micro" character, and is associated with a still more notable one which appears to have escaped his attention—the separation of the eye-plates (which are dorsal), on dehiscence, from the ventral head parts, and their continued attachment to the dorsal head-plate. Another most remarkable "Micro" character, for which I was not at all prepared, is the persistence in the pupæ of some species of the terminal joints of the maxillary palpus as a minute "eye-collar." This, and the following, however, do not occur in any species of which I have had specimens in my own possession, and I therefore mention them with reserve.

Another character is the persistence of the 7th abdominal segment as a free one in the male pupa: this appears to be the case in some species of *Pamphilidi*, but I do not like to be too positive, as one cannot be quite sure on the point with an empty case, unless one is at liberty to dissect and mount it. It is at least certain that the incision appears so open after dehiscence, that if not actually movable, it can only recently have lost its mobility.

These Micro-characters, together with the larval prolegs pointing to *Hepialus* as a possible ancestor, lead one to ask whether there may be any intermediate forms that mark the steps by the way. *Hepialus* is now often instanced as a very archaic form, even as the possible ancestor of everything; *Hepialus* is, however, a terminal form; that is, it is at the end of its line of evolution and has no descendants. This is tolerably clear from its minute antennæ, but especially from the circumstance, remarkable in so early a form (indeed it is the only instance amongst unquestionable "Micros"), that the male pupa has the 7th segment fixed.

The real ancestor that is intended, when *Hepialus* is referred to, is the common ancestor of *Hepialus*, *Cossus*, &c. *Hepialus* retains sundry archaic features of this common ancestor more persistently than *Cossus*,

&c. Although it is a little outside the scope of this paper, yet it is of interest to note that these earliest forms had great variability in respect of antennæ. We find plumose, or at least strongly pectinated, antennæ in some of the earlier Cossids; minute antennæ in *Hepialus*; very long ones in *Adela*. The latter is a good instance of a similar development separately attained; certain Trichoptera have very similar antennæ, and we find the connecting link in *Micropteryx* which has ordinary antennæ, but at the same time possesses the pupal jaws of the Trichoptera and the ovipositing knives of *Adela*.

Now it was somewhere here, amongst these forms with variable antennæ, that the first trace of butterflies with their clubbed antennæ appeared, and some little distance along the road there branched off, as a record thereof, the *Sesiidae*. These latter are unmistakeably "Micros," not, indeed, very far removed from *Hepialus* and *Cossus*, but they have fairly clubbed antennæ. Some considerable distance further on we have *Castnia*, its larva still an internal feeder, and its pupa* still of a *Cossus*-like "Micro" character, but its imagines so very Hesperid-like that they have by some authorities been placed with the butterflies. There are other families that are possibly appendages of this line of evolution, but I know so little about them, and especially about their pupæ, that it is prudent to say nothing further about them at present. Clubbed antennæ are found in Sphinges and in *Zygaena*; in both cases they appear to have been acquired independently of the butterfly stirps, and of each other. This circumstance seems to lend additional force to the idea that clubbed antennæ are in some way specially useful to diurnal species.

To sum up the points in this paper. My chief aim has been to call attention to the study of pupæ, and especially those of butterflies from a broader and more general point of view, and to bring to bear on them the general principles of pupal evolution that were suggested by my study of the Heterocera. The special facts brought out concerning butterfly pupæ are to be taken as largely preliminary and tentative, but it is to be noticed that broadly, and even in some detail, the relationship of the different families to each other suggested, agrees with the ordinary classification. The greatest change of views which appears to be demanded is in relation to the position of the Lycænids, which should no longer be regarded as in any way intermediate between the Papilionids and Nymphalids. Rather should the *Lemoniidae* and *Lycaenidae* be regarded as a branch which developed from the primeval butterfly (above the Hesperids) in one direction, whilst the Papilionids arose and branched to the Pierids and Nymphalids quite independently.† Another point is that the Pierid separated from the Papilionid at a very early stage of the evolution of the latter, and that the Nymphalid almost immediately thereafter separated from the Pierid, at a time, that is, when each yet retained (as many genera do still) both the 5th and 6th abdominal segments free, and before the Pierid had definitely acquired a single instead of a double nose-horn.

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* I am sorry that I have to depend on figures for my knowledge of these.

† I do not wish this to be understood as denying that Papilio must nevertheless be taken as the nearest representative we have of the primary butterfly.

Though, as a matter of fact, the families of true butterflies arose in the order indicated, yet, from our present position in time, we might almost regard them as having arisen simultaneously; each was already separate and distinct, before any of them had made any advance towards the higher sub-families, tribes and genera which are now most characteristic of them.

The primeval butterfly attained by a separate route almost the same pupal structure as the MACRO-HETEROCERA, and gave origin to all the separate families without any substantial change of that structure; but in each family the higher tribes have attained a special and more advanced pupal form, in this respect contrasting with the fixedness of form in the pupa of the MACRO-HETEROCERA and being more in accordance with the manner of evolution of the MICRO-TINEINA.

The numerous very definite MICRO-HETEROCEROUS characters of the Hesperids seem to furnish a clear indication of their derivation, and to enable us to accept the completely micro-characters of *Castnia* and *Sesia* as placing them on the line of butterfly evolution, and not as putting a gulf between them and butterflies. But especially they appear to prove the descent, either by this or by some other route, of the butterflies from the MICRO-HETEROCERA, and to show that, except through the MICRO-HETEROCERA, the butterflies are unrelated to the MACRO-HETEROCERA, with which, however, they are structurally more parallel in many respects; *i.e.*, they are not only as highly, but very similarly differentiated, although quite independently.

It ought, perhaps, to be noted that the Hesperid proper underwent further evolution after the separation of the butterfly stirps.

I have endeavoured to make the relationships of the several forms of pupæ dealt with in this paper more definitely obvious, by using them in the table below as a basis for the general classification of the *Rhopalocera*.

Scheme of Classification of the Rhopalocera founded on the structure of the pupæ.

PAPILIONES.

? (Pupa a true "Micro" = CASTNIIDES).

1.—Pupa broadly a "Macro" but possessing some "Micro" characters = HESPERIDES.

2.—Pupa possessing no "Micro" characters, except, sometimes, a waist or the opening of some incision on dehiscence = PAPILIONIDES.

A.—Clothed with hairs, setæ or bristles; no spines; no intersegmental sub-segment; head beneath thorax; waist marked = LYCAENIDA.

a.—Second leg reaches eyes, separating first leg from antennæ = *LEMONIIDAE.*

1.—Hairs confined to tubercles; 5th and 6th abdominal segments both free (*Euselasia*) = *Erycininae.*

2.—(5th segment only free?).

3.—(One free incision?)

4.—Pupa solid; hairs on general surface = *Nemeobiinae.*

b.—First leg reaches antenna, separating second leg from eyes = *LYCAENIDAE*.

1, 2, 3, ?).

(4 ?).—Hairs on general surface; pupa solid = (*Lycaeninae*).

B.—Hairs very exceptional; spines are processes of pupa; intersegmental sub-segments always present, often marked; head in front; waist often lost = PAPILIONIDA.

a.—Segments (when free) with power of movement in all directions. = *PAPILIONIDAE*.

1.—Thorax not hollowed in front; 5th and 6th abdominal segments free = *Papilioninae*.

2.—Thorax hollowed in front = *Parnassiinae*.

a.—5th and 6th free = THAIDI.

1.—Girth as usual = Clytiini.

2.—Girth to nose-horn = Thaini.

3.—No suspension. = Sericinini.

β.—5th segment alone free. ?

γ.—1st incision alone free = LUEHDORFIIDI.

δ.—Pupa solid. = PARNASSIIDI.

b.—Segments (when free) with antero-posterior movement checked =[*PIERO-NYMPHALIDÆ*].

b1. —Girthed; single nose-spine. = *PIERIDAE*.

1.—5th and 6th segments free. = *Aporinae*.

2.—5th segment free. = *Pierinae*.

„ Pupa curved = *Rhodocerinae*.

3.—(4th incision free) ?

4.—Solid. = *Anthocarinae*.

b2. —Suspended; nose-spine double (except in 1) = *NYMPHALIDAE*.

1.—Nose-spine single. = *Libytheinae*.

2.—5th and 6th segments free. Nose-spines marked. = *Nymphalinae*.

- Acraeidi.
- Vanessidi.
- Argynnidi.
- Heliconidi.
- Nymphalidi.
- Apaturidi.

3.–5th segment free
4.–Incision 4-5 free
5.–Pupa solid
} nose-spines rounded {

- *Satyrinae* (pars) { *Satyrus*. / *Epinephele*.
- „ „ { *Coenonympha*. / *Hipparchia*.
- *α* „ „ { *Melanargia*. / ? *Semele*.
- *β* *Brassolinae*.
- *γ* *Euploeinae*.

There are so many important genera of Nymphalids of which I know nothing, that I do not feel justified in going into more detail, nor in inventing names for the divisions that must unquestionably be made of the *Satyrinae*.

Description of Plate.—With regard to the figures, I would note that they are diagrammatic, but still quite accurate as to all points referred to in the paper, in other matters they may be even imaginative and not to be depended on; the only one of this class, however, of any moment, is as to the antennal articulations, which are put in *ad libitum*, simply to make clear which are antennæ, but without reference to the true number of the joints.

Fig. 1	*Papilio podalirius*	lateral.
,, 2	,, ,,	ventral.
,, 3	*Thais polyxena*	lateral.
,, 4	,, ,,	ventral.
,, 5	,, ,,	dorsal.
,, 6	*Delias aruna*	lateral.
,, 7	,, ,,	ventral.
,, 8	,, ,,	dorsal.
,, 9	*Pieris brassicae*	lateral.
,, 10	,, ,,	ventral.
,, 11	,, ,,	dorsal.
,, 12	*Vanessa levana*	lateral.
,, 13	,, ,,	ventral.
,, 14	,, ,,	dorsal.
,, 15	*Vanessa polychloros*	lateral.
,, 16	,, ,,	face.
,, 17	*Anosia archippus*	lateral.
,, 18	,, ,,	face.
Fig. 19	*Brassolis sophorae*	lateral.
,, 20	,, ,,	face.
,, 21	*Charaxes jasius*	lateral.
,, 22	*Epinephele hyperanthus*	lateral.
,, 23	,, ,,	dorsal.
,, 24	*Euselasia*	lateral.
,, 24A	,,	hair.
,, 25	,,	ventral.
,, 26	,,	dorsal.
,, 27	*Chrysophanus dispar*	lateral.
,, 28	,, ,,	ventral.
,, 29	*Cyclopides palaemon*	lateral.
,, 30	,, ,,	ventral.
,, 31	*Pyrgus malvæ*	lateral.
,, 32	,, ,,	ventral.
,, 33	,, ,,	dorsal.

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3 JUN. 95
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